



INDIA'S HYDROCARBON OUTLOOK



2023-24

A Report on Exploration & Production Activities

DIRECTORATE GENERAL OF HYDROCARBONS
(Ministry of Petroleum & Natural Gas, Government of India)



Creation

Directorate General of Hydrocarbons was formed through a Government of India resolution dated 08.04.1993 under the administrative control of Ministry of Petroleum & Natural Gas.



Objective

To promote sound management of the oil and natural gas resources while having a balanced regard for environment, safety, technological and economic aspects of the petroleum activity.

Disclaimer

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The statistics given in the report are collated from different E&P Companies operating in India and available sources in public domain. The correctness of information given herein, is therefore, subjective to that extent.

Maps are schematic, if not shown with scale.



हाइड्रोकार्बन महानिदेशालय
पेट्रोलियम एवं प्राकृतिक गैस मंत्रालय | भारत सरकार
Directorate General of Hydrocarbons
Ministry of Petroleum and Natural Gas | Government of India

भारत का हाइड्रोकार्बन परिदृश्य
अन्वेषण व उत्पादन गतिविधियों पर एक रिपोर्ट 2023-24

India's Hydrocarbon Outlook
A Report on Exploration & Production Activities 2023-24

KEY HIGHLIGHTS OF 2023-24 (PROVISIONAL)



29.36 MMT

Crude Oil Production



36.44 BCM

Natural Gas Production



14.2 MMT

Accretion of Oil Reserves



35.6 BCM

Accretion of Natural Gas Reserves



67 Active PSCs



188 Active RSCs & 15 Active CBM Blocks

RSC: 133 in HELP & 55 in DSF



358 Active Nomination Acreages

351 PML & 7 PEL Acreages



2376 LKM

2D Seismic Data Acquired under Nomination & Contract Regime



15000 SKM

3D Seismic Data Acquired under Nomination & Contract Regime



741 Wells Drilled

132 Exploratory/Appraisal & 609 Development Wells



INR 5162 Crore*

Profit Petroleum Contribution to Exchequer



INR 9775 Crore*

Royalty Contribution to Central Exchequer

** Provisional*

MMT- Million Metric Tonnes

BCM-Billion Cubic Meter



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हरदीप एस पुरी
HARDEEP S PURI



मंत्री
पेट्रोलियम एवं प्राकृतिक गैस
भारत सरकार
Minister
Petroleum and Natural Gas
Government of India

MESSAGE

India's energy landscape is evolving rapidly, driven by growing consumer demand. This necessitates a robust energy strategy to ensure energy affordability and security while also meeting the considerations of sustainability. Increased Exploration and Production (E&P) and enhancing upstream activities are essential in achieving economic stability. The current geopolitical situation, characterised by volatile crude oil and LNG prices, has accelerated the need for stronger E&P operations to offset India's high import dependence.

Oil and gas are crucial resources in fuelling domestic needs, transportation, and industry. Our long-term policy framework needs constant refinement, with emphasis given to ensuring consistent supply, innovation and efficiency, and building resilience against global shocks. The government has implemented several initiatives aimed at boosting E&P, encouraging both public and private sector participation. 'No Go' areas for exploration in India's EEZ have been reduced by 99 per cent while discovered small fields have been brought into production and the recovery factors of maturing fields augmented. The introduction of the Hydrocarbon Exploration and Licensing Policy (HELP) and the Open Acreage Licensing Policy (OALP) have facilitated the substantial increase of E&P. These initiatives have simplified bidding processes, increased transparency, and attracted substantial investments.

Since its inception in 1993, the Directorate General of Hydrocarbons (DGH) has played a significant role in helping India achieve its strategic objectives. This 31st publication of "India's Hydrocarbon Outlook" by DGH provides a comprehensive overview of these developments and other aspects of India's oil and gas sector. I am certain it will be a valuable resource that offers insights into the trends and prospects of the sector, and hope that it will be a useful reference guide for stakeholders.


(Hardeep S Puri)

New Delhi
06 July 2024



SURESH GOPI

सुरेश गोपी

राज्य मंत्री

पेट्रोलियम एवं प्राकृतिक गैस

और पर्यटन

भारत सरकार

**Minister of State for
Petroleum & Natural Gas
and Tourism
Government of India**

The growth in energy demand in India is escalating progressively over the years, underpinned by strong economic and demographic growth. As the world's third-largest energy consumer, India's role in global oil and gas markets is set to grow significantly, with energy demand expected to more than double by 2040. This surge in demand highlights the critical need to ensure energy accessibility for India's 1.4 billion citizens.

To address this concern and secure the nation's energy future, the government is focused on ramping up domestic production by enhancing the Oil and Gas Exploration and Production (E&P) sector in all aspects. The government has introduced several proactive policies to unlock the full potential of India's 26 sedimentary basins. Key initiatives include reforms in the licensing policies in India, providing fiscal benefits to the sector players, implementation of the National Seismic Programme (NSP) for un-appraised areas, National Data Repository (NDR and NDR 2.0) and push towards decarbonizing the E&P sector in India.

Furthermore, the Discovered Small Fields (DSF) and Coal Bed Methane (CBM) policies were also announced based on the principle of 'ease of doing businesses' to promote the smaller players, increase participation of private companies and strengthen the overall ecosystem. The success of the DSF Policy is corroborated by the fact that the DGH awarded 84 Contract Areas, attracting investments worth US\$ 2 billion, and facilitated entry of 15 new players. The recent announcement of a special round of auctions for 3 Contract Areas under the DSF regime highlights the popularity of the policy among the sector players.

These policies have been instrumental in attracting both domestic and foreign investment. By continuously investing, embracing technological innovations, and enhancing infrastructure, the upstream sector remains central to the growth of the oil and gas industry. Given the sector's lucrative investment opportunities, India is encouraging strategic collaborations and partnerships with domestic and global leaders to enhance domestic production, while decarbonizing the sector using groundbreaking pathways such as CCUS, Geothermal etc. In the next decade, these policies and collaborative efforts will not only drive the growth of the upstream sector but also play a pivotal role in achieving the goal of energy security, affordability, and sustainability for the nation.

With the vision to elevate India's E&P operations, the Directorate General of Hydrocarbons (DGH) has played a vital role in shaping the exceptional growth of nation's oil and gas sector. DGH has consistently provided the government with crucial policy advisory and technical assistance.

The 31st Annual publication, "India Hydrocarbon Outlook: 2024" encapsulates all the major developments of India's upstream oil and gas sector and showcases the contributions of DGH. I am confident that this handbook will prove to be an essential guide for industry leaders, policymakers, and experts, dedicated to empowering the E&P sector in India.

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पंकज जैन
सचिव

Pankaj Jain
Secretary



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July 8, 2024



The trajectory of growth of the nation's energy demand is underpinned by sustained fast-paced economic growth, increasing population and rapid rates of urbanization. The country is projected to account for about 33% of the global growth in energy demand by 2040 and fossil fuels such as oil and gas would continue to play a critical role in meeting our energy requirement even as simultaneously, huge efforts are underway for energy transition. As we continue to import very large quantities of crude oil and gas, there are implications for energy security. This necessitates a collaborative and comprehensive approach with coherent strategies to strengthen India's domestic Exploration and Production (E&P) capabilities and significantly improve outcomes.

Notwithstanding global challenges in the supply chain, the country has continued to make steady gains in implementing a multi-pronged strategy to increase domestic production and encourage exploration activities. Exploration-focused bidding and monetization of marginal fields under several HELP-OALP, DSF and Special CBM rounds, supplemented by a slew of procedural reforms, fiscal incentives and policy changes have been acknowledged by industry players and will yield positive results. The fiscal benefits offered for adopting EOR technologies and the changes to contract regime have been instrumental in attracting investments and interest of E&P companies.

Investment opportunities are emerging, as our oil and gas market continues to grow, driven by factors such as robust economic growth, necessity of energy security, strategic supply management by the government and geopolitical scenario across the globe. Techniques such as Advanced seismic imaging, 3D/4D seismic surveys etc. have successfully reduced exploration risks and optimized production strategies, leading to improved efficiency and profitability for the operators. Furthermore, the integration of digital technologies in the upstream sector has revolutionized real-time monitoring of processes and facilities, enabled predictive maintenance and automated operational decision-making. Our endeavors towards fostering a conducive environment for collaboration between industry, policymakers, academia, investors, service providers and professionals are meant to enable innovation, investment, and operational excellence – crucial for sustainable growth and resilience of the Indian upstream oil and gas sector.

The Directorate General of Hydrocarbons (DGH) is dedicated to driving growth and development in domestic E&P sector and continues to play a crucial role in shaping its future. The 31st edition of the DGH Annual Publication "India's Hydrocarbon Outlook 2023-2024" offers a detailed summary of the accomplishments and progress made in the Indian E&P sector in the last fiscal year, encompassing key statistics, trends and data, providing valuable insights that enable informed decision making and strategy planning. I take this opportunity to acknowledge the commitment and the diligent effort by the team at the Directorate General of Hydrocarbons for compiling this comprehensive and insightful compendium. I am confident that it will serve as an invaluable resource for all stakeholders of the industry. Any suggestions for improvements to this document, as well as ideas to bolster the Indian upstream hydrocarbon sector would be welcome

[Pankaj Jain]



**MESSAGE BY
DIRECTOR GENERAL, DGH**

India's energy demand is growing rapidly, driven by economic development, urbanization, and industrial expansion. It thus makes it imperative for the energy needs of the country to have a stable and increased supply of oil and gas production domestically to meet this growing demand.

Exploration and production (E&P) play a vital role in India's pursuit of energy security. With more than 85% of its crude oil requirements currently being imported, India is highly vulnerable to fluctuations in global markets and geopolitical tensions. Projections indicate that India's primary energy demand will double by 2045, underscoring the urgent need to enhance domestic production capabilities. By intensifying E&P efforts, India can tap into both discovered and undiscovered hydrocarbon reserves thereby reducing dependence on imports. Moreover, robust E&P activities drive technological innovation and infrastructure development, critical for sustainable energy management. Notably, the recent Hydrocarbon Exploration and Licensing Policy (HELP) aims to enhance domestic production through simplified licensing and favorable fiscal terms. Overall, a strong E&P sector is essential for economic resilience, affordable energy, and the realization of India's long-term energy security objectives.

The Directorate General of Hydrocarbons (DGH) is dedicated to promoting and bolstering hydrocarbon production within India. Our strategic endeavors aim to strengthen domestic exploration and production and move towards providing a consistent and dependable energy supply for the nation.

Impressive achievements have been attained under the Open Acreage Licensing Policy (OALP). So far, we have awarded Oil Blocks up to Bid Round-VIII, spanning an impressive 242,056 square kilometers. Looking ahead, the ongoing OALP Bid Round-IX and upcoming Bid Round-X are poised to exceed expectations, projecting an estimated coverage cumulatively of 570,056 square kilometers. This substantial expansion holds great promise for enhancing our exploration capabilities.

Additionally, the growing interest in previously designated 'NO-GO' areas, such as the Mahanadi Basin and new gas discoveries, present a significant opportunity for India's energy sector. So far, 12 hydrocarbon discoveries have been made in OALP blocks and one is currently under production.

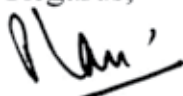
DGH has placed significant emphasis on data-driven exploration. Notably, DGH has completed extensive seismic surveys, such as Exclusive Economic Zone (EEZ) Survey of 1,00,000 LKM including Andaman Offshore and AGG Survey of about 42,943 LKM in Cauvery, Bastar and Northeast India. Looking ahead, DGH is committed to additional projects such as Mission Anveshan (involving 20,275 LKM of Close Grid 2D Seismic Survey in onland), Stratigraphic Wells in 4 sedimentary basins in offshore and the Extended Continental Shelf survey (involving 2D Seismic Acquisition of 30,000 LKM). These initiatives will go a long way in supporting data driven hydrocarbon exploration and production activities in the country.

Beyond these efforts, the Discovered Small Fields (DSF) rounds have attracted proactive engagement from 29 new companies, which is an encouraging indicator of industry's keen interest in this sector. Additionally, we are increasingly focusing on Coal Bed Methane (CBM), a crucial resource that needs to be utilized to boost India's energy security and tap into the unexploited potential of our hydrocarbon reserves. The current production rate stands at 2.0 MMSCMD, which is expected to reach 5.2 MMSCMD by 2026-27.

To improve the ease of doing business, DGH has introduced several measures. The Urja Pragati Platform aids in statutory clearances in coordination with state governments and other ministries, while the Urja Suraksha Samanvay, a GIS-based monitoring decision support system, facilitates swift information exchange. Approvals on self-certification route reduce procedural delays, and the Upstream India Portal enhances collaboration among exploration and production stakeholders.

Through this 31st publication of "India's Hydrocarbon Outlook – 2023-2024", we aim to present a comprehensive review of India's upstream sector. We hope it serves as a valuable reference for all industry stakeholders, reflecting our dedication to transparency and progress in the hydrocarbon industry.

With Best Regards,



Dr. Pallavi Jain Govil

1

A Pioneering Journey: The Story of Oil Exploration in India



The story of India's oil exploration journey began in the 19th century, specifically in the northeastern corner of the country.

🕒 Early Discoveries and Attempts (1828-1889)

The story of India's oil exploration journey began in the 19th century, specifically in the northeastern corner of the country. Members of the Geological Survey of India (GSI), C.A. Bruce (1828) and H.B. Medicott (1865), stumbled upon oil seepages while searching for coal in Upper Assam. Inspired by Edwin L. Drake's drilling of the world's first oil well in Pennsylvania, USA (1859), attempts at oil exploration began in Assam.

The initial hand-dug well by Stewart & Company in 1866 near Jeypore proved unsuccessful. However, the following year, Assam's first mechanically drilled well struck oil at just 118 feet, marking a significant milestone in oil exploration in India.

🕒 Shifting Landscape and New Players (1889-1937)

The Assam Railways and Trading Company (AR&T Co. Ltd.) took a crucial step in 1889 by digging a well at the Digboi field. This well yielded commercially viable oil



production, leading AR&T to acquire petroleum rights in the Makum area. Subsequently, AR&T established the Assam Oil Company (AOC) in 1899 to manage these newfound resources.

AOC's efforts included setting up a small refinery at Margherita. Later in 1901, Asia's first Oil Refinery was set up at Digboi which continues to operate today, holding the distinction of being the world's oldest continuously operating refinery.

The early 20th century saw the arrival of the UK-based Burma Oil Company (BOC) in Upper Assam (1911). BOC gradually acquired oil business interests in the region, eventually taking over AOC's holdings by 1921.

Meanwhile, the Tata Engineering Company of India also made its mark by drilling wells in Gujarat during the 1930s, leading to small-scale gas production.

A pivotal moment arrived in 1937 when BOC, along with British Petroleum and Shell, proposed a geophysical survey of key Indian plains. This proposal was accepted, paving the way for a new approach to oil exploration.

The successful seismic survey conducted in Naharkatiya during 1937-39 marked a turning point. This innovative method not only yielded positive results in the form of well NHK-1 but it also fueled renewed enthusiasm for oil exploration across India, leading to future discoveries in Assam and other basins.

Dawn of Independence & New Era: Recognizing Oil's Importance, Building Expertise and Establishing Institutions and Taking Charge (1947-1955)

With India's independence in 1947, the nation's leadership understood the crucial role oil played in rapid industrialization and national security. The colonial-era policies designed to serve the British Empire's raw material needs were revamped. The development of a robust domestic petroleum industry became a top priority during the formulation of the 1948 Industrial Policy.

By 1948, the Geological Survey of India (GSI) embarked on a geophysical survey in the Cambay area. This period also saw the first oil discovery in independent India, achieved by the Assam Oil Company (AOC) in Naharkatiya (1953) and Moran (1956), both located in Upper Assam. However, foreign companies, primarily BOC, continued to dominate the oil industry for a considerable period after independence.

Recognizing the need for domestic expertise, a delegation led by Mr. K.D. Malviya, the Minister of Natural Resources, visited European countries in 1955-56. This visit aimed to study their oil industries and facilitate training for Indian professionals. Additionally, foreign experts were invited to share their knowledge. The erstwhile USSR played a significant role by assisting in the creation of a detailed plan for geological, geophysical surveys, and drilling projects within India's Second Five-Year Plan (1956-1961).

The Birth of ONGC and Early Discoveries (1955-1969)

With the aim of intensifying exploration efforts across the country, the Oil and Natural Gas Directorate was established in 1955 as a subordinate office under the Ministry of Natural Resources and Scientific Research. Staffed primarily by geoscientists from the GSI, it soon became evident that a more empowered entity was needed.

In early 1956, the Directorate's status was upgraded to a Commission. The Oil and Natural Gas Commission (ONGC) was further strengthened by an Act of Parliament in October 1959, granting it statutory body status and broader powers while remaining under the Ministry's purview.

ONGC's mandate was clearly defined: to plan, organize, and execute programs for petroleum resource development, production, and sale of petroleum products. Additionally, it could undertake any other function assigned by the central government.

Following a systematic approach, ONGC initiated geophysical surveys in prospective areas identified through global comparisons.



Priority was given to regions like the Himalayan foothills and adjoining Ganga plains, Gujarat's alluvial tracts, Upper Assam, and Bengal's basins. While exploratory drilling in the Himalayan foothills during 1957 proved unsuccessful, ONGC achieved a significant breakthrough within a year of its formation by discovering oil at Cambay.

Subsequent years witnessed a string of discoveries under ONGC's leadership: Ankleshwar (1960) and Kalol (1961) in Gujarat, Lakwa (1964) and Geleki (1968) in Assam, and a gas discovery (Manhera Tibba) in Rajasthan (1969).

Oil India Limited: A Strategic Partnership (1959)

In February 1959, Oil India Limited (OIL) was incorporated as a rupee company to expedite exploration and development activities in Assam's Naharkatiya and Moran fields. Established to take over BOC's Assam operations, OIL was initially a joint venture with a two-thirds ownership by AOC/BOC and one-third by the Government of India. This partnership evolved into an equal partnership by 1961, marking a significant step towards greater Indian control over its oil resources.

Consolidation and Expanding Horizons (1960s-Onwards)

India's quest for offshore oil and gas began in 1962 with a pioneering effort by ONGC. Their initial foray involved an experimental seismic survey in the Gulf of Cambay, a crucial first step in unlocking the potential beneath the ocean floor. This exploration spirit continued in the western offshore region, where detailed seismic surveys led to a significant discovery in 1972-73: a large structure in the Bombay Offshore. Subsequent drilling confirmed the find, resulting in India's biggest commercial oil discovery – the Bombay High field.

The success of Bombay High spurred a wave of exploration activity. Determined to replicate this achievement, both ONGC and OIL expanded their efforts to other offshore

areas. This extended not only along the western coast but also to the east, encompassing regions with promising geological formations. These initiatives yielded significant discoveries, including the Bassein and Neelam fields in the western offshore and the PY-3 and Rawva fields in the eastern offshore.

While ONGC was initially focused on the western offshore, OIL, traditionally active in Assam, ventured beyond its base in 1978. They embarked on exploration activities in the Orissa offshore and onshore regions, demonstrating a strategic shift towards a broader national exploration strategy. OIL's ambition further expanded with forays into the Andaman offshore (1979-89) and Rajasthan onshore. By the end of the 1980s, this collective effort by ONGC and OIL had resulted in the drilling of nearly 3,100 wells, a testament to their unwavering commitment to India's energy security.

Beyond oil exploration, ONGC also undertook extensive geoscientific surveys across various Indian states. Their investigations spanned Uttar Pradesh, Bihar, Tamil Nadu, Rajasthan, Jammu & Kashmir, Kutch and Andhra Pradesh. These meticulous surveys, coupled with advanced exploration techniques, bore fruit by the mid-1980s. ONGC successfully identified promising prospects in the Cauvery and Krishna Godavari (KG) basins, laying the groundwork for future discoveries.

A significant emphasis on offshore exploration was also placed on identifying natural gas reserves as well. This resulted in the discovery of several major gas fields. In 1976, OIL discovered the Kharsang oilfield, which also contained valuable gas reserves. That same year, ONGC made a landmark discovery with the Bassein field off Mumbai's coast, one of India's biggest gas finds. This success story continued with further discoveries by ONGC, including the Mid-Tapti, South Tapti, and B-55 gas fields.

Despite the impressive discoveries, the late 1970s also exposed limitations in India's exploration capabilities. The country primarily relied on its National Oil Companies (NOCs)



– ONGC and OIL – for exploration activities. However, these companies faced constraints in terms of technology, expertise, and investment capital needed for deeper offshore exploration.

Recognizing these limitations, the government took a strategic initiative in 1979. To attract foreign investment, technology and expertise, Government of India, offered 32 exploration blocks (a mix of offshore and onshore) through a bidding process. These bidding rounds, known as Pre-NELP exploration rounds, aimed to foster collaboration between Indian NOCs and international players. While the initial three rounds held between 1980-1986 witnessed limited success, they marked a shift in India's approach to exploration, paving the way for future collaborations.

Government Takeover and Continued Exploration:

The government further consolidated its role in the oil and gas sector by taking over Oil India Private Limited in 1981, transforming it into a full-fledged public sector undertaking (PSU). This move aimed to streamline operations and strengthen India's domestic exploration efforts.

Exploration activities continued throughout the 1980s, with both ONGC and OIL making significant discoveries. In 1982, ONGC made a major gas discovery in Gandhar, Cambay basin, Gujarat. By 1986, the KG basin emerged as a major player with several significant discoveries. This period also saw the third round of international bidding for exploration blocks in 1986. While foreign participation remained limited, the government offered participating companies a 40% back-in right during the development phase, incentivizing future collaborations.

New Strategies and a Brighter Future for India's Oil and Gas Exploration

Opening Doors for Private Participation (1990s)

In a bid to revitalize the petroleum sector, the Government of India (GoI) introduced more attractive investment opportunities in 1994.

However, this period also saw disagreements regarding Production Sharing Contracts (PSCs).

Undeterred, ONGC ventured into Coal Bed Methane (CBM) exploration in the Damodar Valley and explored Enhanced Oil Recovery (EOR) options in North Gujarat's heavy oil belt. By 1996, the GoI had conducted five bidding rounds, offering 126 exploration blocks ranging from 1 sq. km. to a massive 50,000 sq. km.

This shift towards a more open market attracted not only National Oil Companies (NOCs) and Indian private companies but also major international players like Shell, Enron, Aramco, and Occidental. Contracts for exploration activities were awarded to these companies, with Hindustan Oil Exploration Company (HOEC), established in 1991, being one of the first domestic private players to enter the fray.

The Birth of DGH and the New Exploration Licensing Policy (NELP)

Recognizing the need for an independent regulatory body in the liberalized oil and gas sector, the GoI established the Directorate General of Hydrocarbons (DGH) in 1993. The DGH's primary responsibility was to oversee oilfield development programs and ensure sound reservoir management practices aligned with national interests.

Following the nomination era (pre-1980s), the pre-NELP exploration era (1980-1995), and pre-NELP field rounds (1993-1994), the GoI formulated the New Exploration Licensing Policy (NELP) in 1997. This policy aimed to attract significant investments, cutting-edge technologies and best practices from both domestic and foreign companies. The ultimate goal was to enhance India's geological understanding of its sedimentary basins and effectively explore its oil and gas resources to meet the nation's growing energy demands.

Implemented in 1999, NELP introduced a competitive bidding system for exploration licenses. NOCs were required to compete with Indian and foreign companies on an equal footing to secure Petroleum Exploration Licenses (PELs). Nine rounds of bidding were



conducted under NELP, resulting in the signing of production sharing contracts for 254 exploration blocks. This period also witnessed the commercial opening of two major basins: Rajasthan and Krishna-Godavari.

A Shift Towards Revenue Sharing and Renewed Global Interest

NELP successfully opened the Indian E&P sector to private and foreign players. However, ongoing investor interactions highlighted the need for further policy reforms, particularly regarding Production Sharing Contracts. Recognizing these concerns, the government made a significant shift towards Revenue Sharing Contracts with the introduction of the Discovered Small Field Policy (DSF, 2015) and the Hydrocarbon Exploration and Licensing Policy (HELP, 2016).

Recent policy interventions and project facilitation efforts have generated renewed global interest in the Indian oil and gas industry. The participation of foreign companies in the already held DSF and Open Acreage Licensing Programme (OALP) bidding rounds is a testament to this positive development.

The Road Ahead: Big Discoveries and Unveiling Subsurface Potential

With a vast scope of activities and the government's continued focus on development, the Indian oil and gas sector holds immense promise for future discoveries. Recent resource reassessment studies and expert opinions on new plays and deepwater exploration suggest a definitive push towards revealing previously unknown subsurface resources and creating a more realistic picture of India's hydrocarbon potential. The Indian E&P sector stands poised for a significant leap forward in the years to come.

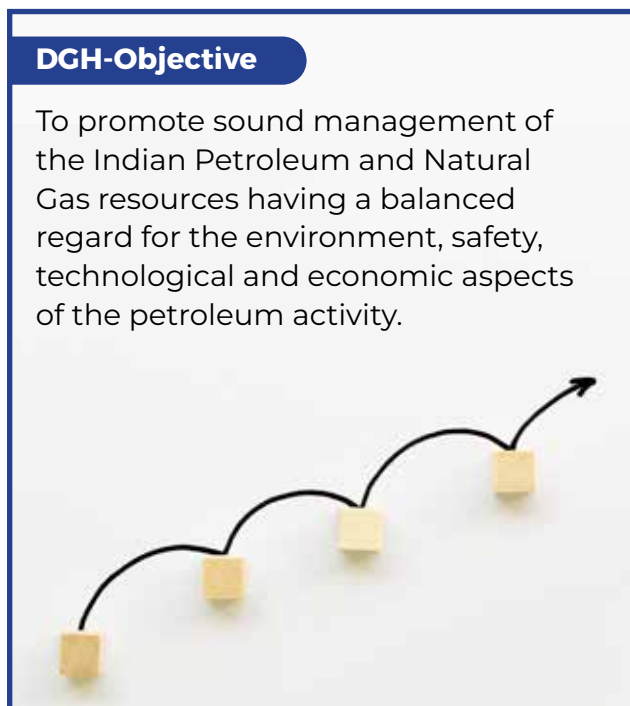
1.1 Formation of Directorate General of Hydrocarbons (DGH)

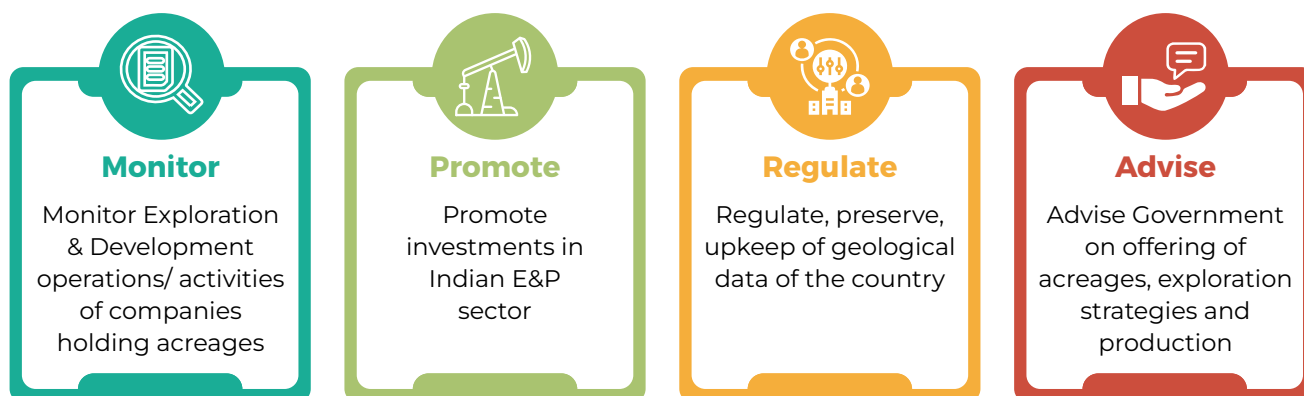
During early nineties, Ministry of Petroleum and Natural Gas, Government of India had under consideration, the need to have an appropriate

agency to regulate and oversee the upstream activities in the petroleum and natural gas sector and advise the Government in these areas. The Dasgupta committee, which had reviewed the management of the Bombay High reservoir, had recommended the creation of an autonomous conservation board to oversee and review that oilfield development which conforms to sound reservoir engineering practices in line with national interests. Subsequently, the Kaul committee, which examined ONGC's organizational structure, also recommended for establishment of an independent regulatory body called the Directorate General of Hydrocarbons. Moreover, the upstream petroleum sector was largely a monopoly of public sector companies till then and sector at that time was being increasingly opened to new operating companies in the private and joint sectors. Thus, a need was felt to establish an agency that could effectively supervise the activities of all these companies in the national interest. Taking all the above into consideration, Government of India, decided to set up a Directorate General of Hydrocarbons (DGH) under the administrative control of the Ministry of Petroleum and Natural Gas. DGH was set up through a Government Resolution No. O-20013/2/92/ONG-III dated 8th April 1993.

DGH-Objective

To promote sound management of the Indian Petroleum and Natural Gas resources having a balanced regard for the environment, safety, technological and economic aspects of the petroleum activity.





DGH has been entrusted with multifaceted functions and responsibilities which include:

- Providing technical expertise and advice to the Ministry of Petroleum and Natural Gas on pertinent issues related to the exploration and optimal exploitation of hydrocarbons in India and abroad by national oil companies.
- Scrutinizing and assessing the exploration programs of companies holding Petroleum Exploration Licenses (PELs) under the oilfields (Regulation and Development) Act, 1948 and the Petroleum and Natural Gas Rules, 1959, with a view to advising the government on the adequacy of these programs.
- Re-evaluating the estimated and discovered hydrocarbon reserves in coordination with the operating companies.
- Advising the government on the allocation of exploration acreages to companies and matters concerning the relinquishment of such acreages.
- Reviewing the development plans proposed by operating companies for commercial discoveries of hydrocarbon reserves, assessing the feasibility of these plans and the proposed exploitation rates, and making recommendations to the government.
- Concurrently reviewing and monitoring the management of petroleum reservoirs by operating companies and advising on any corrective actions required to ensure optimal exploitation of reserves and conservation of petroleum resources.
- Regulating the storage, maintenance, and preservation of data and samples related to petroleum exploration, drilling, and production, and preparing data packages for the allocation of exploration acreages to companies.
- Undertaking other incidental functions and any other responsibilities as assigned by the government from time to time.

1.2 Governance

Advisory Council

The Directorate General of Hydrocarbons has an Advisory Council that is appointed by the Government and consists of a Chairman and members who are distinguished individuals in the field of hydrocarbon exploration and production. The Directorate provides support to the Advisory Council and is headed by the Director General, who also serves as the Member Secretary to the Council.

Administrative Council

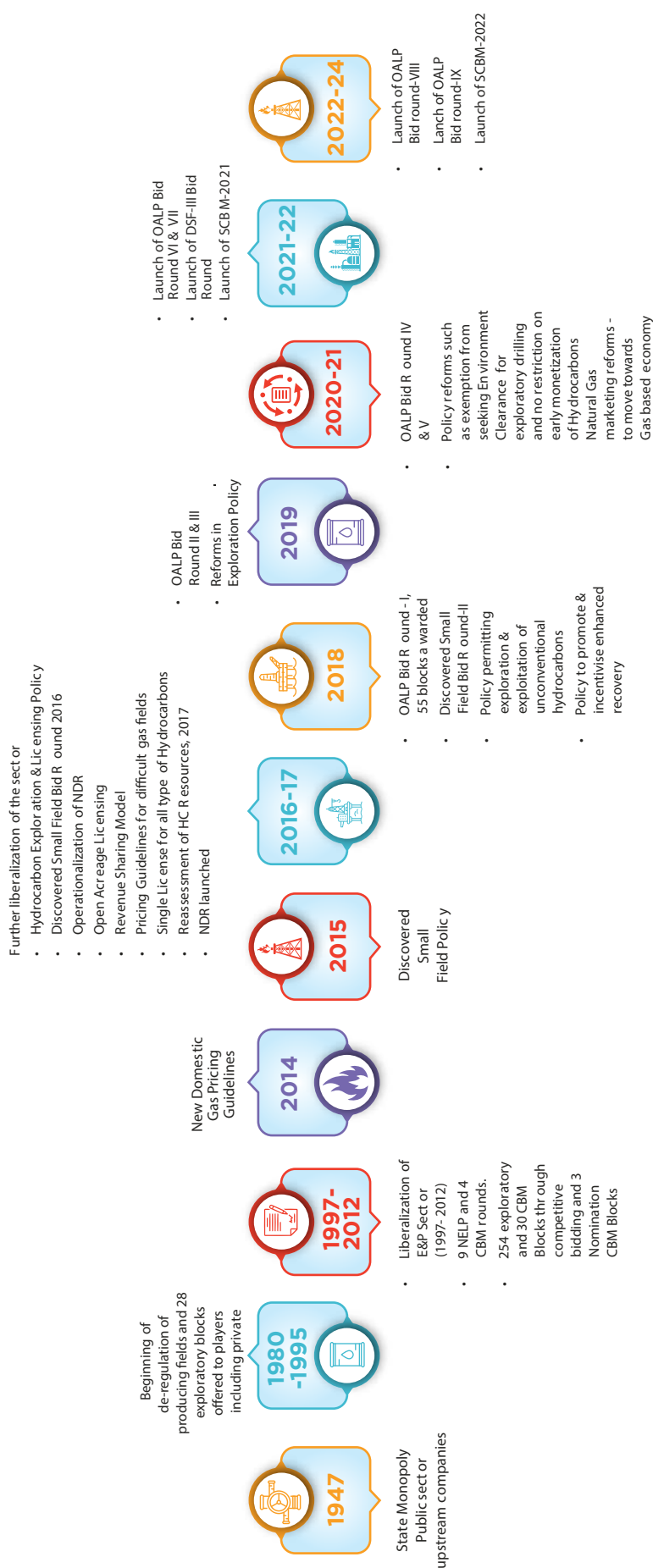
The Government of India established an Administrative Council on February 2nd, 2001, through Office Memorandum No. O-32012/1/95-ONG-III dated 2.2.2001, to provide guidance and oversee all administrative aspects of the DGH's operations. The Administrative Council is responsible for making decisions related to establishment, budgeting, and conducting periodic reviews of the DGH's functioning. It is chaired by the Secretary (P&NG) and comprises the following members:



Table 1.1: DGH Administrative Council

Name	Designation
Secretary, MoP&NG	Chairman
Additional Secretary, MoP&NG	Member
AS&FA, MoP&NG	Member
Joint Secretary (Exploration), MoP&NG	Member
Secretary, OADB	Member
Director General, DGH	Member-Convener



**Nomination Era****1947****Pre-NELP PSCs****1980****CBM Contracts/NELP PSCs****1997****DSF/HELP RSCs****2015****2024**

1.3. Acreages under various Regimes

Petroleum Exploration Licenses (PEL) for domestic exploration & production of crude oil and natural gas were/are being granted under various regimes.



1.3.1 Nomination Basis

Till the end of 1970s, Indian E&P industry was dominated by the two National Oil Companies (NOCs) ONGC and OIL to whom PELs were granted on nomination basis. Exploration was primarily confined to onland and shallow offshore areas.

1.3.2 Production Sharing Contracts



a. Pre-NELP Exploration Blocks

28 Exploration blocks were awarded to private companies between 1980 and prior to implementation of NELP where ONGC and OIL had the rights for participation in the blocks after hydrocarbon discoveries.



Table 1.2: Pre-NELP Exploration Blocks

Year	Exploration Rounds	Contracts Signed			
		Description	Offshore	Onshore	Total
1980	First Round	PSC Signed with Chevron, USA and 3 wells were drilled without success. Block area was relinquished in 1985	1	-	1
1982	Second Round	No PSC signed	-	-	-
1986	Third Round	-	-	-	-
1991	Fourth Round	5 PSC signed	2	3	5
1992		First development round	-	-	
1993	Fifth Round	Second development round	4	2	6
1993	Sixth Round	First speculative survey round	2	3	5
1994	Seventh Round	-	2	3	5
1994	Eighth Round	Second speculative survey round	1	3	4
1995	Ninth Round	JV Exploration program	1	1	2
Total			13	15	28

In 1993, GoI offered blocks for geophysical and other surveys to update the information on hydrocarbon potential of India's unexplored sedimentary basins. Once the surveys on these blocks were completed, they were to be offered in subsequent rounds of exploration. The second speculative survey round was launched in 1994 and the third round in 1995. The third round was called as Joint Venture Speculative Survey Round (JVSSR) with a provision of risk participation/ cost sharing by DGH upto 50%. Government of India has signed 28 contracts for blocks offered under Pre-NELP Exploration regime.

b. Pre-NELP Discovered Field or Development Rounds

Government offered Petroleum Mining Lease (PML) of small/ medium sized discovered fields (proven reserves were discovered by ONGC and OIL) to the private sector in August 1992. Production Sharing Contracts (PSCs) awarded during 1991-1993 had the distinctive feature of operators as private companies with ONGC/ OIL as having participating interest. These rounds received overwhelming response from various private E&P operators. Government of India has signed 28 contracts (One PSC for Panna Mukta-PM) for 29 discovered fields under Pre-NELP Discovered (Small and Medium size fields) regime.

Table 1.3: Pre-NELP Discovered Field or Development Rounds

Month/Year of Award	Round	Blocks offered in Medium sized Field Round		Blocks offered in Small sized Field Round		Contracts signed
		Offshore	Onshore	Offshore	Onshore	
August, 1992	1	6	6	10	21	18
October, 1993	2	2	6	4	29	10
Total Contracts signed						28



c. New Exploration Licensing Policy (NELP)

In a bid to revitalize India's oil and gas exploration, the government implemented the New Exploration & Licensing Policy (NELP) in 1999. This policy introduced a game-changer competitive bidding for exploration blocks. Previously dominated by state-owned National Oil Companies (NOCs) like ONGC and OIL, NELP opened the doors for private and foreign companies to participate. This created a level playing field, fostering healthy competition and public participation in the sector. The impact was far-reaching. NELP not only accelerated the exploration efforts but also attracted a wave of new players. From a mere 35 companies (including PSUs, private and foreign) before NELP, the number ballooned to a whopping 117 after nine rounds of bidding. This surge

included a significant rise in private and foreign participation, bringing with them cutting-edge technology and efficient management practices.

NELP's influence extended beyond just numbers. It paved the way for deep-water exploration, previously considered a significant hurdle. These discoveries proved to be a boon for the industry, accelerating exploration, enabling deep-water oil and gas production, and infusing the E&P sector with much-needed technology and investment. In total, a staggering 1.5 million square kilometers were awarded through bidding, with Production Sharing Contracts (PSCs) signed for a massive 254 exploration blocks across various terrains, including onland, shallow water, and deep-water areas. Round wise details are as follows:

Table 1.4: NELP Bid Rounds

Round	Launch Year	Signing Year	PSC Signed
NELP-I	1999	2000	24
NELP-II	2000	2001	23
NELP-III	2002	2003	23
NELP-IV	2003	2004	20
NELP-V	2005	2005	20
NELP-VI	2006	2007	52
NELP-VII	2007	2008	41
NELP-VIII	2009	2010	32
NELP-IX	2010	2012	19

So, in summary a total of 310 Production Sharing Contracts were signed, out of which 67 Contracts are operational as on 31st March, 2024. Details of Operational blocks can be found at Annexure.

1.3.3 Revenue Sharing Contracts

In recent years, the domestic upstream sector has witnessed substantial policy reforms and progressive decisions. As part of a major

initiative to boost the upstream hydrocarbon sector, E&P industry has transitioned from Production Sharing Contracts (PSCs) to Revenue Sharing Contracts (RSCs). This strategic shift aims to achieve greater transparency, operational flexibility, risk-sharing, and increased investor appeal.

RSCs simplify revenue sharing, reduce bureaucratic complexities, and create a conducive environment for oil and gas



exploration. The objective is to enhance efficiency, attract investment, and foster a competitive landscape within India's energy industry.

Accordingly, two major policies formulated to implement the Revenue Sharing Mechanism are :

a. Discovered Small Field Policy (DSF)

In 2015, the Indian government introduced a significant policy shift for the oil and gas sector with the Discovered Small Field (DSF) policy. This policy aims to unlock the potential of previously discovered, but undeveloped, small hydrocarbon reserves. DSF offers attractive fiscal terms to investors and companies, including the elimination of oil cess on crude oil production, reduced royalty rates, and freedom in pricing and marketing of oil and gas.

Additionally, there's no upfront signature bonus or carried interest for National Oil Companies (NOCs). This translates to a more streamlined and commercially viable development process for these fields. The DSF policy operates under a revenue-sharing mechanism, granting contractors greater autonomy with minimal government oversight. Three successful bidding rounds have been conducted so far, awarding a total of 85 Contract Areas. As on 31st March, 2024, 55 Contract Areas are active.

Introduction of DSF has demonstrably revitalized the sector by attracting over new E&P players, bringing fresh investment and expertise to Indian exploration and production (E&P) activities.

Contract Areas awarded round wise are as below:

Table 1.5: DSF Round wise Award

Round	Launch Year	Signing Year	No. of Contract Areas Awarded
DSF-I	2016	2017	30
DSF-II	2018	2019	24
DSF-III	2021	2022	31

Further details about DSF can be found at Chapter-6.

b. Hydrocarbon Exploration and Licensing Policy (HELP)

In a landmark move to revitalize India's oil and gas exploration sector, the government introduced the Hydrocarbon Exploration Licensing Policy (HELP) on March 30th, 2016. This policy marked a significant shift, transitioning from a Production Sharing mechanism to a Revenue Sharing model. This streamlined approach reduces government intervention in day-to-day operations, fostering a more business-friendly environment (Ease of

Doing Business). A key component of HELP is the Open Acreage Licensing (OAL) mechanism. This empowers exploration companies to select their own blocks, eliminating the need to wait for government-led bidding rounds. The first bid round under OAL was launched in January 2018, and since then, eight successful rounds have been conducted within a six-year period. These eight rounds have resulted in the awarding of a staggering 144 exploration blocks, encompassing a vast area of 2,42,057 sq. km., providing a significant boost to E&P activities in India.



Table 1.6: OALP Bid Round details

OALP Bid Round	Launch Year	Blocks Awarded
OALP-I	19-01-2018	55
OALP-II	07-01-2019	14
OALP-III	10-02-2019	18
OALP-IV	27-08-2019	7
OALP-V	14-01-2020	11
OALP-VI	06-08-2021	21
OALP-VII	16-12-2021	8
OALP-VIII	07-07-2022	10
Total	-	144

Further details about HELP can be found in Chapter-6.

The domestic crude oil/gas production in the country consists of oil/gas production from

**Nomination Blocks/
Fields under ONGC
and OIL**

**The discovered fields
and producing Pre-NELP,
NELP blocks under the
Production Sharing
Contract (PSC) regime**

**The contract areas
(CAs) Awarded under
DSF (Revenue sharing
contracts)**

Investment made under contract Regime (PSC & RSC) in USD Million (As of 31-03-2024)

India, a country with a booming economy and ever-increasing energy needs, prioritizes investment in hydrocarbon Exploration and Development (E&P). These investments are vital for guaranteeing the nation's energy security and fulfilling its future fuel demands. The government has introduced policy reforms

to attract investments and make the sector more appealing. This includes opening up vast unexplored sedimentary basins and offering globally competitive terms to investors. As a result, E&P companies are participating in exploration and development activities, infusing much-needed capital into the sector.

The investment made under Contract Regime (PSC+RSC) is as below:



Table 1.7: Cumulative Investment made in Contract Regime in USD Million (As of 31st March, 2024)

Bidding Round	Contract Signing Year	Committed Investment		Actual Investment upto 2023-24*		
		Type	Value	Exploration	Development	Total
Pre-NELP Blocks	1985-1995	Exploration	NA	2522	8251	10773
Pre-NELP Fields	1992-1993	Development	NA	596	5884	6481
Pre-NELP Total			NA	3118	14135	17253
NELP-I	2000	Exploration	1082	5189	16327	21516
NELP-II	2001	Exploration	775	910	34	944
NELP-III	2003	Exploration	978	3401	2094	5495
NELP-IV	2004	Exploration	1135	2100	37	2137
NELP-V	2005	Exploration	3570	1029	111	1140
NELP-VI	2007	Exploration	1505	2842	30	2872
NELP-VII	2008	Exploration	1102	993	4	997
NELP-VIII	2010	Exploration	734	849	0	849
NELP-IX	2012	Exploration	847	286	2	288
NELP Total			11728	17600	18638	36238
DSF-I	2017	Development	3000	37	114	151
DSF-II	2019	Development		33	49	81
DSF-III	2022	Development		-	29	29
DSF Total*			3000	69	192	261
OALP - I	2018	Exploration	815	444		444
OALP -II	2019	Exploration	452	139		139
OALP - III	2019	Exploration	709	370		370
OALP - IV	2020	Exploration	341	95		95
OALP - V	2020	Exploration	62	150		150
OALP-VI	2022	Exploration	600	154		154
OALP-VII	2022	Exploration	158	16		16
OALP-VIII	2024	Exploration	233	0.19		0.19
OALP Total			3370	1369	0	1369
Grand Total				22156	32965	55122

Note 1: Actual Investment upto 2023-24 is a provisional and are subject to examination and adoption of Audited Accounts.

Note 2: DSF Committed Investment is based on Submitted FDP

Note 3: Sum may not match because of round-off



Initiatives for Ease of Doing Business

The Government has prioritized the ease of doing business in the Exploration and Production (E&P) sector, with the goal of boosting investment and production. The simplification of procedures and processes results in a more transparent and efficient system, which encourages investment in the sector.

In the era of digital revolution, the government is striving to enhance process efficiency and improve the delivery of government services. A range of measures have been implemented to simplify and digitize the processes throughout the E&P sector's value chain. DGH, under the Ministry of Petroleum and Natural Gas (MoPNG), has taken numerous steps to facilitate and streamline the process of granting Licenses and Clearances.

Moreover, the government has introduced several systematic reforms in the sector, including the 'Self-Certification'. This allows for major processes/approvals to be granted swiftly based on self-certification.

In line with this vision, the Government, through DGH, has launched a variety of applications and systems. These tools assist operators with smooth operations, transparent contract management, expedited approval & clearance grants, and engagement with potential investors.

1. **Production Sharing Contract Management System (PSCMS):** Launched on 1st April 2019, PSCMS is a workflow-based system with 61 PSC processes requests for approval to clear proposals and manage contracts contract management for PSC Blocks/Fields.
2. **PSC Self-certification (Simplification of procedures and processes under Production Sharing Contract of Pre-NELP/ NELP Blocks)** Under the Self-Certification, the contractual processes have been placed online and the contractors are required to submit proposals on a self-certification basis in a standardized format.

3. **Petroleum Exploration Lease/Petroleum Mining Lease Data Management System:** Launched on 5th November 2019, PEL/PML application is an online application for operators to apply for PEL/PML under various contractual regimes (Nomination/ PSC/RSC/CBM).
4. **Production Database Management System (PDMS):** An online Production Database Management System (PDMS) has been implemented wherein all oil and gas production data on daily basis is uploaded by operators for Nomination and PSC regime. The portal enables to view, monitor and analyze block, field and asset wise production.
5. **Revenue Management System (RMS):** The system aims to collate the details of Revenue generated in respect of sale of oil, gas and condensates produced in the block. This also facilitates monitoring of Royalty (currently functional for offshore blocks) & Profit Petroleum (PP). Integration of RMS Application with Bharatkosh has gone live from 01.04.2021.
6. **Accounts Management System:** The system captures electronically and collates the details of audited accounts submitted to DGH.
7. **Non-Tax Remittance Management System:** The system is aimed to overcome the reconciliation the system is aimed to collate Details of remittance/payment made (towards Non-Tax Revenue) to Pay & Account office of MOP&NG/State Government under PSC/CBM contracts under the following heads and interest thereon.
8. **EOI Submission portal for OALP:** EOI submission portal was launched in 2016 for the operators to submit Expression of Interest (EOI) for the identified blocks under OALP bid rounds.



9. **E-bidding portal:** DSF/OALP/SCBM Bids were invited through online e-bidding portal.
10. **Site Restoration Fund Management portal:** DGH has developed an online portal to streamline the operationalization of Site Restoration Fund (SRF) Scheme 1999.
11. **Initiatives for facilitating clearances/ approvals and enhanced coordination:**
 - a. **Empowered Coordination Committee (ECC):** This committee has been constituted under the chairmanship of Cabinet Secretary to discuss the defense, environment, license etc. related issues pertaining to the Hydrocarbon sector.
 - b. **Creation of 'Hydrocarbon Clearance Cell' (HCC):** A dedicated 'Hydrocarbon Clearance Cell' has been institutionalized within DGH. The cell liaises with Central/State Government authorities for expeditious grant of clearances/approvals.
 - c. **Creation of North-East Coordination Committee (NECC):** ECC under HCC of DGH created in September 2021 and 18 Coordinators are placed with various Departments of State Govts of Assam, Arunachal Pradesh and Tripura for ease of processing Clearance and Approval proposals under various environmental regulations as well as expediting the other issues related to Oil & Gas E&P activities requires administrative/regulatory supports from the State Govt.
 - d. **Urja Pragati Portal (Upstream Response by Joint Action for proactive Governance and Timely Implementation):** To facilitate E&P operators and monitor the approvals/clearances, URJA PRAGATI web-based interactive portal has been launched recently by DGH to prioritize and flag the long pending issues concerning the upstream hydrocarbon sector involving various stakeholders such as Operators, Central Ministries and State Governments. The issues to be dealt through this portal covers clearances related to PEL (Petroleum Exploration License), PML (Petroleum Mining Lease), FC (Forest Clearance), WLC (Wildlife Clearance), CTE (Consent To Establish)/CTO (Consent To Operate), ESZ (Eco Sensitive Zone) and CRZ (Coastal Regulation Zone).
 - e. **Upstream India Portal:** The 'Upstream India' portal was launched to provide support to E&P operators. It offers services such as sharing of facilities and infrastructure available at DGH, creation of a Knowledge Sharing Platform, and organization of regular workshops, seminars, conferences, training sessions, and discussions on the latest government policies, technologies, and usage of inventories.
 - f. **Urja Suraksha Samanvay:** GIS based monitoring and decision support system for swift information exchange.
 - g. **PM Gatishakti Portal:** Bringing all the available information of the upstream sector onto a single platform.



KEY MILESTONES OF INDIAN E&P SECTOR



1890

- First Commercial 1890 Discovery at Digboi, Assam



1882

- Assam Railway Trading Company set up to explore oil

1867



- Struck Oil in Jeypore



1891

- Burmah Oil Company bought shares from ARTC, and appointed commercial and technical managers from AOC

- Assam Oil syndicate set up a refinery at Margherita, Assam



1922



1901

- First Oil Refinery Set up at Digboi, Assam

1895



- Assam Oil Company to take over petroleum interest from Assam Oil Syndicate

1930



- Crude Oil Production rose upto 2,50,000 tonnes per annum and exploration activities continued in Assam-Arakan range

1997-1999



- GoI formulated CBM Policy
- GoI approved NELP
- NELP-I launched offering 48 blocks

1987-1993



- Ravva Oil Field discovered in KG Offshore
- DGH Established
- ONGC is re-organised as a corporation

1981-1986



- Oil India Ltd became wholly owned GoI Enterprise
- Discovery of Gandhar Oil field, Gujarat
- GoI decision for participation of private companies in development of discovered oil and gas fields
- Neelam Oil Field, Mumbai

1974-1977



- Bombay High discovered
- Discoveries of Bassein Gas Field, Mumbai Offshore, Kharsang oil field, Arunachal Pradesh
- Discovery of Heera oil field, Mumbai Offshore

1959-1961



- ONGC became statutory body
- Discovery of Ankleshwar oil field, Gujarat
- Oil India Pvt Ltd incorporated as 50% JV between GoI and BOC

1956



- Oil and Natural Gas Commission established
- Discovery of oil in Moran, Assam

1953



- Discovery of Naharkatia Oil Field, Assam

1948



- Industrial Policy Resolution passed
- Oil fields Regulation and Development) Act, 1948 came into existence

- Second Round of CBM blocks bidding
- NELP-IV launched



2003

2000-2002



- NELP-II launched with 25 blocks on offer
- First round of CBM bidding
- NELP-III launched offering 27 blocks



2004
2005

- Mangala Oil Field discovered in Rajasthan
- Third Round of CBM bidding
- NELP-V launched offering 20 blocks

2006



- NELP-VI launched offering 55 blocks
- MA Oil Field, KG Offshore Discovered



- NELP-IX launched with 34 blocks on offer

2010

2008- 2009



- Fourth round of CBM bidding
- NELP-VIII launched with 70 blocks on offer

2007



- NELP-VIII launched with 57 blocks on offer
- CBM extension policy introduced
- Discovery of D1 & D3 Gas Fields, KG offshore

2014-2015



- Domestic Natural Gas Pricing guidelines
- Approval and launch of Hydrocarbon
- Resource Reassessment Study
- Discovered Small Field Policy



2023-2024

First Oil Production from Challenging Deep Water Block KG-DWN-98/2 (Cluster-II) in KG-Basin



**2022
2023**

- Launch of OALP Bid Round - VIII
- Launch of OALP Bid Round - IX
- Launch of SCBM-2022

- Launch of OALP Bid Round VI & VII
- Launch of DSF-III Bid Round
- Launch of SCBM-2021



2020-2021



2019-2020

- Launch of OALP Bid Round II, III, IV & V
- Self-Certification of PSC processes
- Natural Gas Marketing Reforms, 2020



2018

- Launch of OALP Bid Round-I, DSF Bid Round-II
- Enhanced Recovery Policy

- Launch of NDR
- Launch of HELP through OALP
- Early monetization of CBM
- Extension policy for Pre-NELP Contracts



2017



2016

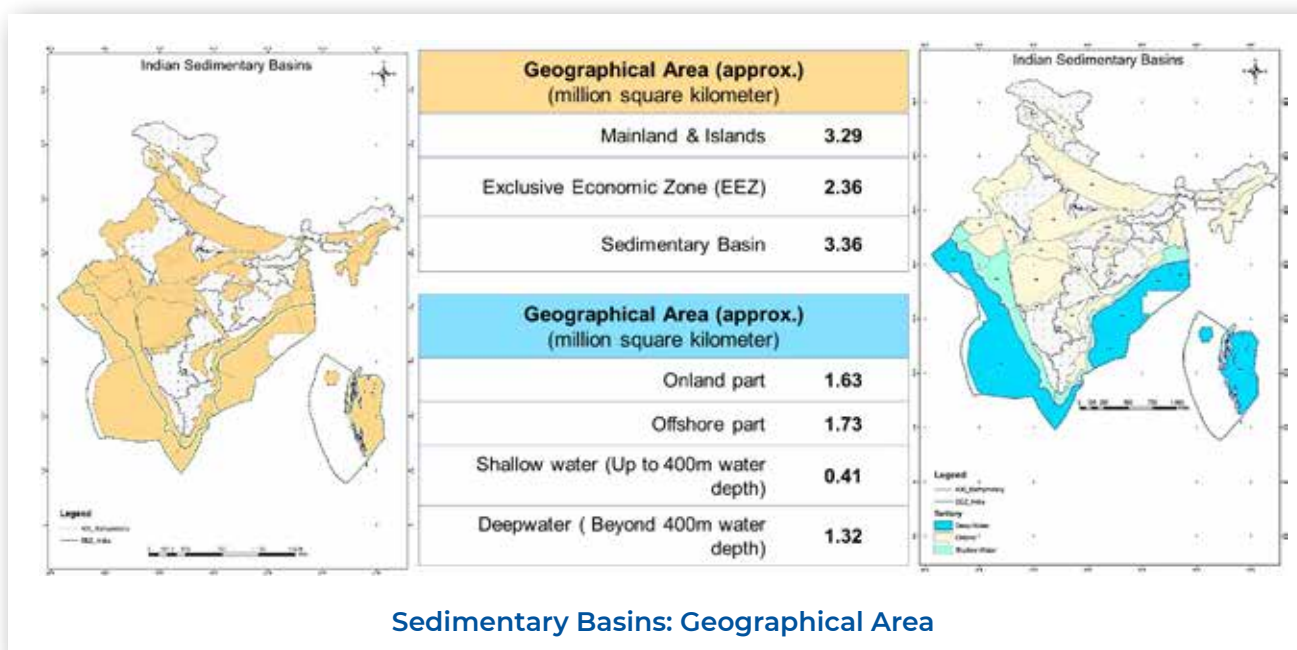
- Approval of Hydrocarbon Exploration Licensing Policy (HELP)
- Marketing and Pricing freedom for new gas production from Deepwater, Ultra Deepwater and High Pressure- High Temperature Areas

2

India's Petroliferous Basins: Prospectivity Insights



India has thick sedimentary rocks with proven petroleum systems. The country is one of the 171 petroleum provinces independently mapped by U.S. Geological Survey (USGS) in 2012. The basin area occupies 50% of country's onland area and 73% of country's offshore within Exclusive Economic Zone (EEZ).

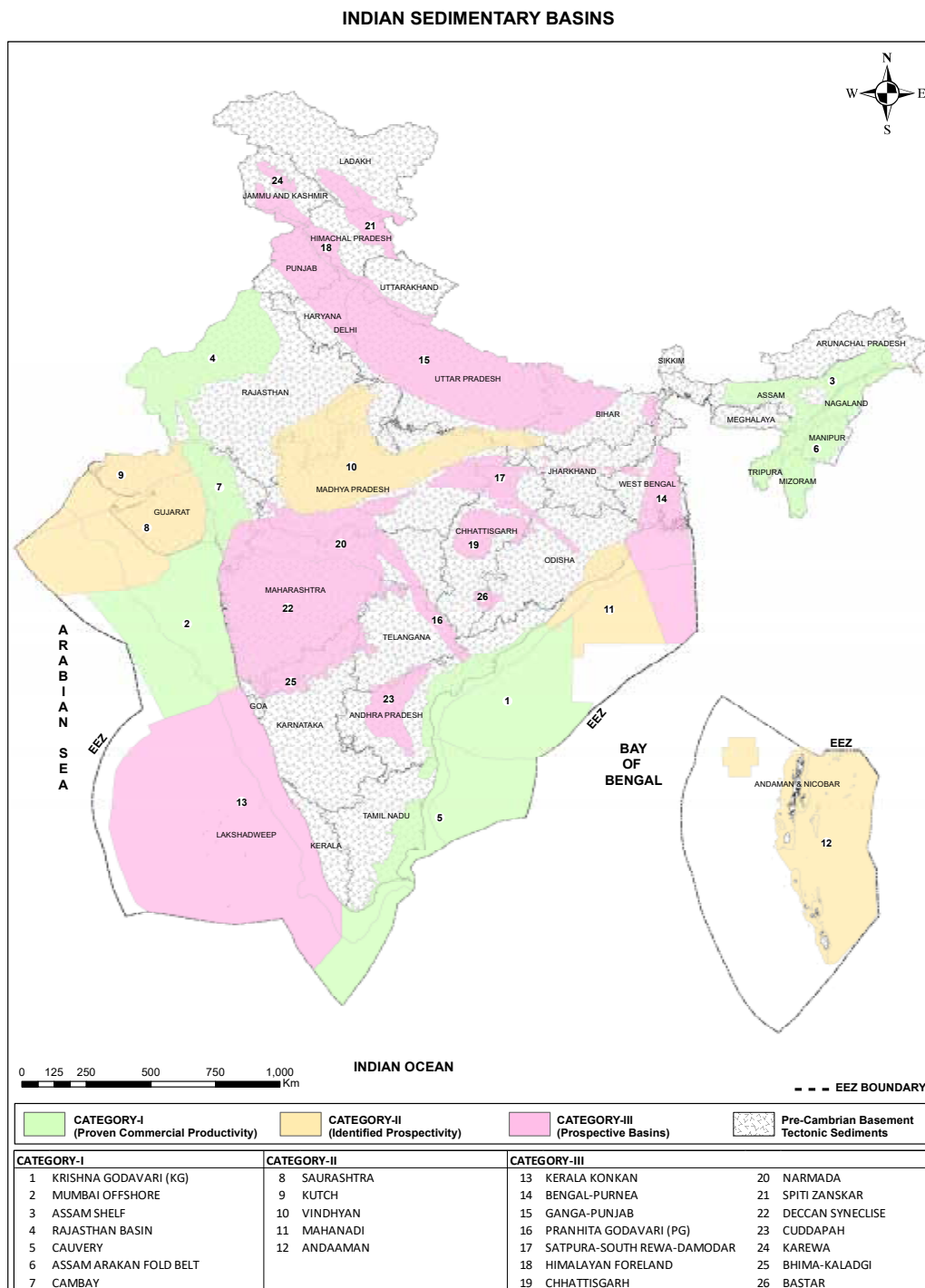


Source: DGH Internal



With 26 sedimentary basins mapped and assessed, India has discovered petroleum of 12.0 billion ton oil equivalent and undiscovered potential of 12.9 billion ton oil equivalent, which is duly weighed with geologic risks. While this is an estimate of conventional petroleum occurrence, unconventional petroleum exists in form of coal seam gas, shale plays, tight plays, basement fractures and gas hydrate.

Sedimentary basins are divided into three categories mapping conventional resources and following the rationale of Petroleum Resources Management System (PRMS), a global standard for reporting petroleum resources and reserves based on techno-commercial merits.



Source: DGH Internal



The category of basins is subject to upgrade upon change in resource maturity at basin scale. Category III basin may be upgraded to Category II in case, there is a discovery or Category II to I, if discoveries are commercially produced. Since category is linked to resource maturity, basin grouping will be meant

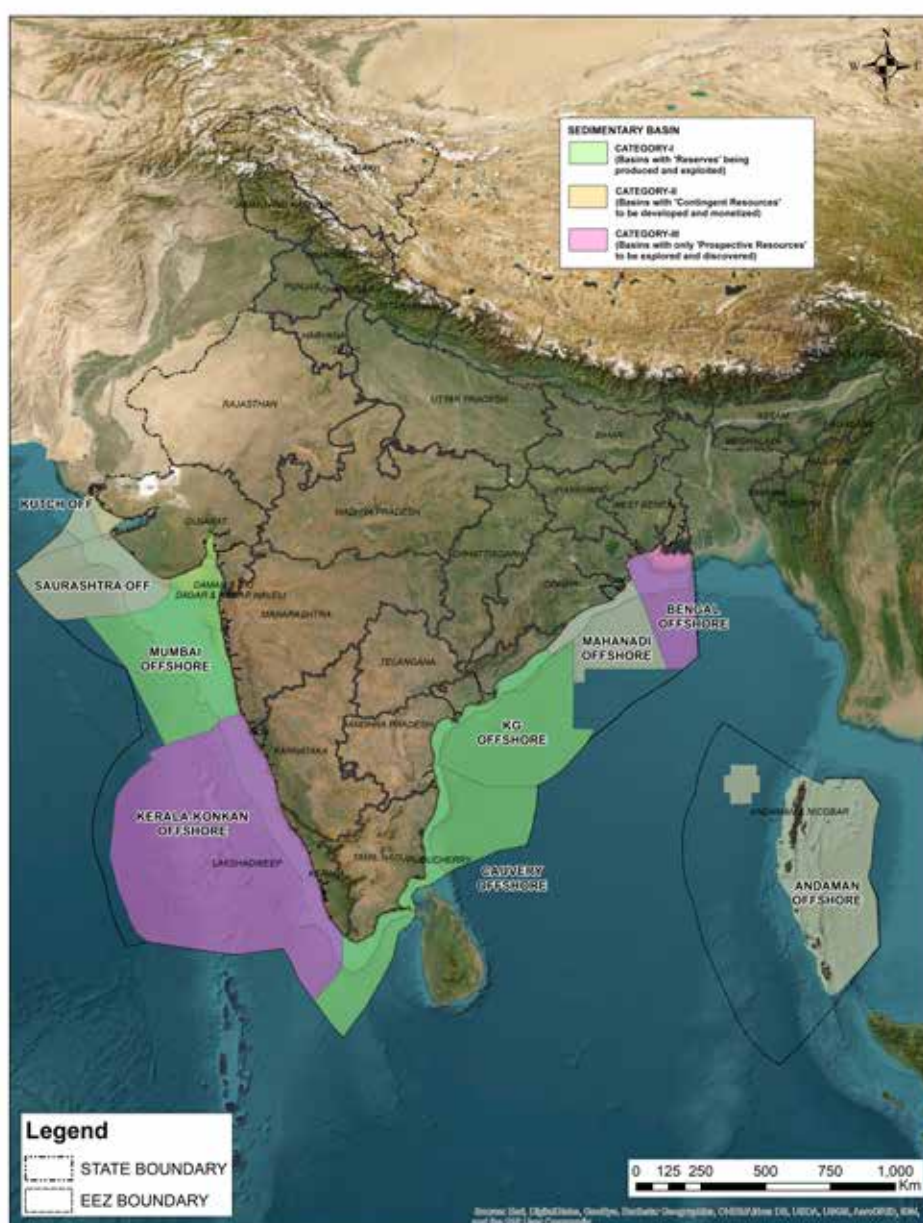
differently to conventional and unconventional resources. For example, Satpura-South Rewa-Damodar basin is a Cat III basin for conventional resources, which are yet-to-be discovered, but it will be deemed Cat I basin for unconventional (Coal Bed Methane) as it is commercially producing CBM gas.

INDIA'S OFFSHORE BASINS

There are 9 offshore basins having an area of 1.73 million sq km, out of which 0.41 million sq km is located in shallow water up to bathymetry

of 400m and 1.32 million sq km in deepwater. The water depth beyond 1,500m is recognized as ultra-deepwater.

INDIAN SEDIMENTARY BASINS : OFFSHORE



Source: DGH Internal



GOVERNMENT'S INITIATIVES FOR OFFSHORE EXPLORATION:

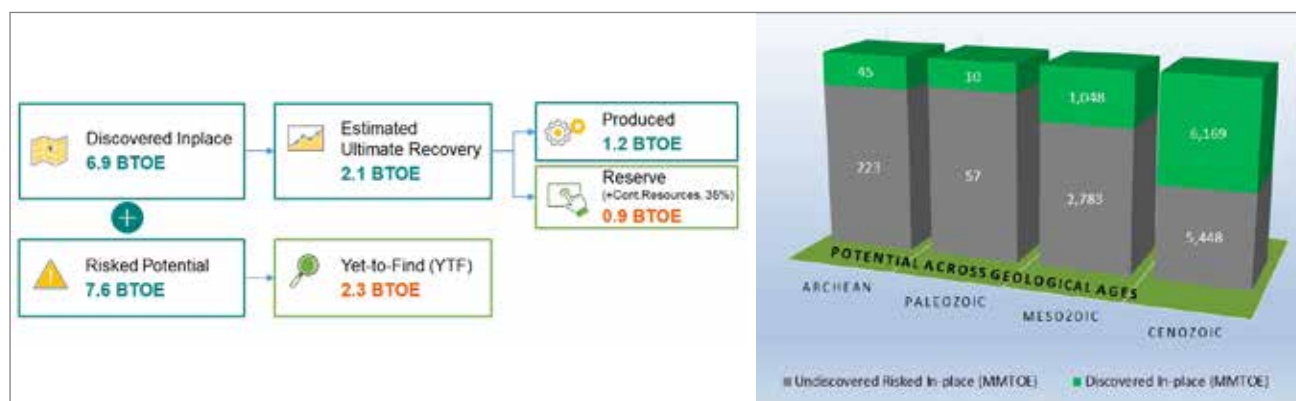
Until September 2022, offshore area was restricted for E&P operation with "No-Go" overlap of 1,366,708 sq km (57% of total offshore). In a landmark initiative, GoI, in a coordinated manner through ministerial participation had reduced the "No-Go" area to 24,832 sq km, opening up 99% of 2.36 million sq km of India's EEZ. As an immediate follow-up, large size blocks were offered by suitable amendment to Model Revenue Sharing Contract (MRSC). Further to this, many Undefined Basin Areas (UBAs) in Mahanadi and Andaman basins were studied using new datasets and found extended from contiguous basin areas by geological analogy. Such areas, considered at that time as UBAs were duly approved for bidding, subject to future review during basin re-mapping under the next Hydrocarbon Resource Assessment Study (HRAS).

Unlike the provision required for onland acreage, statutory clearances for offshore are directly administered by Union Government, as a result, such approvals are simpler and faster

for offshore proposals. In terms of availability of datasets, offshore deepwater is 100% appraised, while shallow water is 90%, implying a scope for holistic assessment of subsurface geology. With 6.9 billion ton oil equivalent of discovered potential (58% of country's total estimate of 12.0 billion ton oil equivalent), the exploration activity into deepwater is still largely subdued. Given the fact that largest deepwater gas deposit, located in deepwater channels of Krishna Godavari basin has produced ~3.0 trillion cubic feet of natural gas, there are vast areas now open for intense exploration.

In a major move, National Data Repository(NDR) sold a significant volume of geoscientific datasets (both East and West coast basins) as per NDR data policy to two global service providers, whereby NDR data were value-added for objective sale to interested parties. This has opened up excellent opportunities to use improvised datasets in the subsurface assessment workflows, much needed for well-informed bidding of exploration blocks.

OFFSHORE HYDROCARBON POTENTIAL:



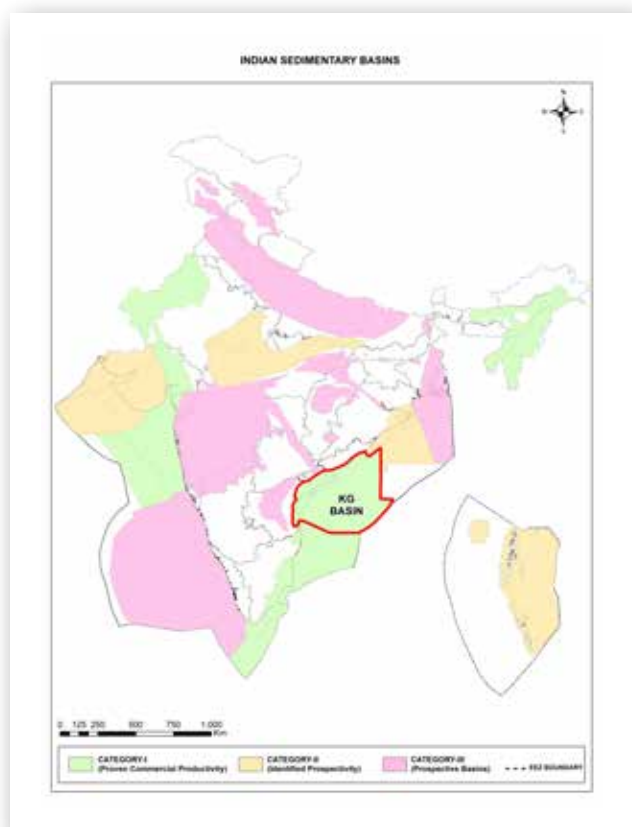
Source: DGH Internal



1. KRISHNA-GODAVARI (KG) BASIN

Krishna-Godavari (KG) is a Category I basin, implying that the basin has significant commercial discovered inplace, potential to be produced at an optimum level.

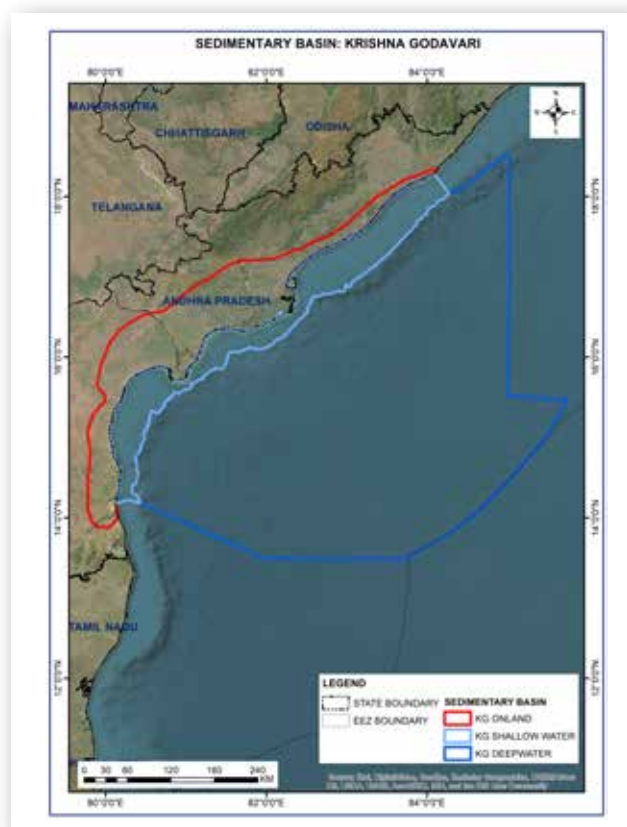
The geographical area of the basin partially overlaps with the state of Andhra Pradesh.



Source: DGH Internal

Krishna-Godavari (KG) is located along the east coast of Indian peninsula, lying between Mahanadi basin in the north and Cauvery basin towards south. The basin is most prospective and largely proven with maximum resources (38% of total offshore), and is known for country's largest deepwater gas field. Both deepwater and shallow water are extensively appraised with large-scale datasets, which is an opportunity for intensive exploration of stratigraphic traps, majorly the channelized deposits.

Commercial hydrocarbon occurrences spread over a wide stratigraphic horizons ranging from Permian to Pliocene with geographical distribution over onland, offshore including ultradeep bathymetry. Several oil and gas



Source: DGH Internal

fields have been discovered, both onland and offshore.

The KG basin consists of sediments with thickness of more than 7,000m, ranging in age from the Early Permian to Recent. The basin's onland part is mostly covered by the alluviums deposited by the two major river systems, viz., Godavari and Krishna and several stratigraphic sequences including Lower Gondwanas that are outcropped near the basin margin.

The reservoirs are primarily sandstones with isolated occurrences of limestone and unconventional reservoirs like fractured basalts. Effective source rocks are identified to be the shales of Permian to Eocene. Biogenic reservoirs and gas hydrate deposits have been established in the basin.



Facies propagation in deepwater calls for mapping with high resolution seismic and well data. Synrift and Eocene plays can be targets for exploration. Intensive exploration is an opportunity to unfold immense prospectivity of the basin.

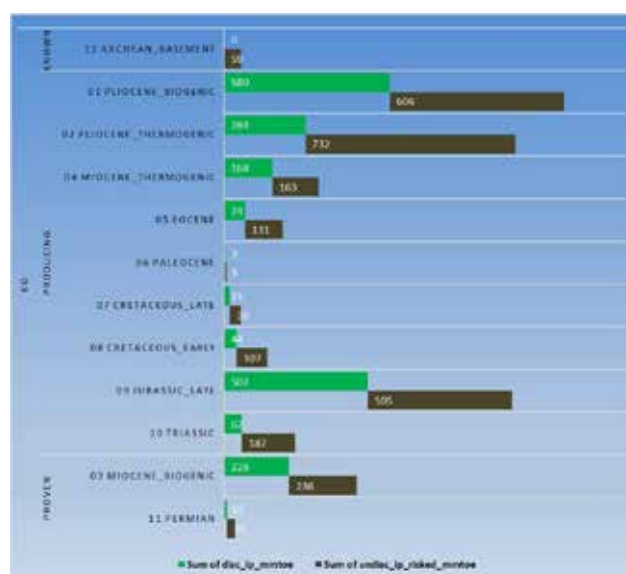
A total of three petroleum systems have been identified in the entire basin with multiple sources rocks in the onland part. Good Total Organic Carbon (TOC) of 1.5-13.5% are known from formations like Kommugudem, Gollapalli, Nandigama, Palakollu Formations. The discovery history plot of KG Basin confirms that the basin is still in the active stage of exploration.

Hydrocarbon prospectivity and Basin maturity:

In the basin, 10 thermogenic plays are identified within Basement, Permian, Mesozoic, Paleocene, Eocene, Miocene, Pliocene. Besides, 2 biogenic plays have been established in Mio-Pliocene sequences. Petroleum system was modelled in 3D basis, as KG basin has adequate data-sets.

Krishna-Godavari (KG) basin has a total hydrocarbon in-place of 4,772 MMTOE. This includes discovered in-place of 1,976 MMTOE and undiscovered risked in-place of 2,796 MMTOE.

The discovered in-place is under commercial production. The basin has 58.6% of total in-place, potential to be explored and discovered.



Source: DGH Internal

Discoveries and Development:

3 field development plans were reviewed during the year under DSF regime in Shallow water.

2 field development plans were reviewed during the year under NELP regime in Deepwater.

Overview of producing fields:

Commercial production in Onland sub-basin commenced in 1994. Major producing fields with cumulative production in parenthesis are namely Pasarlapudi (12 BCM), Kesavadasapalem (5 BCM), Kesanapalli West (3 MMT, 2 BCM), Endamuru (2 BCM), Gopavaram (1.6 MMT). The sub-basin has 40 fields with 251 wells. The maximum flow rates achieved by any field on record in 2023-24 are, Oil 1,580 BOPD and Gas 1 MMSCMD.

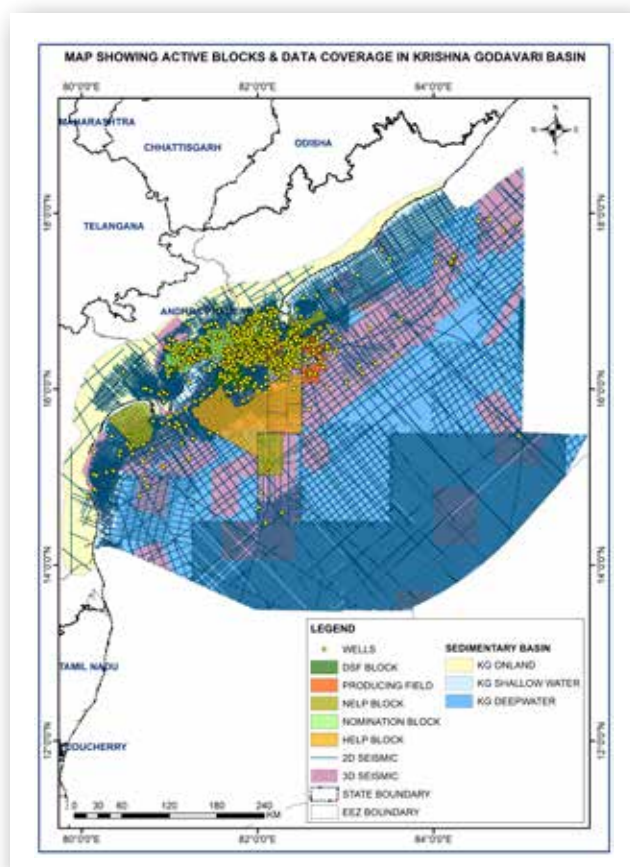
Commercial production in Shallow water sub-basin commenced in 1994. Major producing fields with cumulative production in parenthesis are namely Ravva (42 MMT, 13

BCM). The sub-basin has 11 fields with 48 wells. The maximum flow rates achieved by any field on record in 2023-24 are, Oil 9,300 BOPD and Gas 1 MMSCMD.

Commercial production in Deepwater sub-basin commenced in 2008. Major producing fields with cumulative production in parenthesis are namely KG-DWN-98/3 (4.7 MMT, 104 BCM), KG-DWN-98/2 (0.1 MMT, 1 BCM). The sub-basin has 3 fields with 25 wells. The maximum flow rates achieved by any field on record in 2023-24 are, Oil 20,600 BOPD and Gas 29 MMSCMD.



Basin datasets, studies and opportunities:



Source: DGH Internal

As of 31.03.2024, NDR has archived data of 291,039 LKM 2D seismic, 292,285 SKM 3D seismic and 1,439 wells.

Under various campaigns by GoI, geophysical data were acquired, initially in onland basins and later, extended to offshore areas.

Under National Seismic Programme (NSP), 981 LKM 2D seismic data were acquired.

In another initiative, titled Mission Anveshan 4,561 LKM 2D seismic are planned as an in-fill data acquisition campaign of NSP.

The offshore was part of 8,234 LKM East Coast EEZ 2D seismic survey.



Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised(skm)	Active area (skm) across regime
Onland	31,456	31,456 (100%)	Nomination: 4,277; Fields: 67; DSF: 818
Shallow water	25,649	25,649 (100%)	Nomination: 473; Fields: 338; NELP: 2,496; OALP: 242; DSF: 1,233
Deepwater	172,895	172,895 (100%)	Nomination: 132; Fields: 1,174; NELP: 2,425; OALP: 7,532; DSF: 336

The basin occupies an area of 230,000 sq km. It has been appraised to the extent of 230,000 sq km. (100%). The active area under operation across regime(s) stands at 21,543 sq. km.

Current Bidding Opportunities:

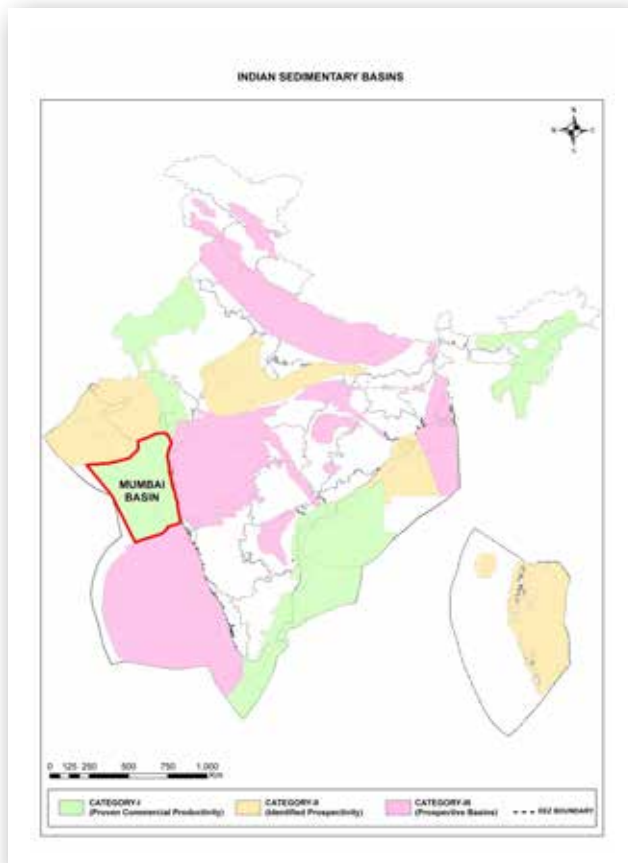
Shallow water:	1 OALP block with 2,968 sq km area
Deepwater:	5 OALP blocks with 50,775 sq km area



2. MUMBAI OFFSHORE BASIN

Mumbai Offshore is a Category I basin, implying that the basin has significant commercial

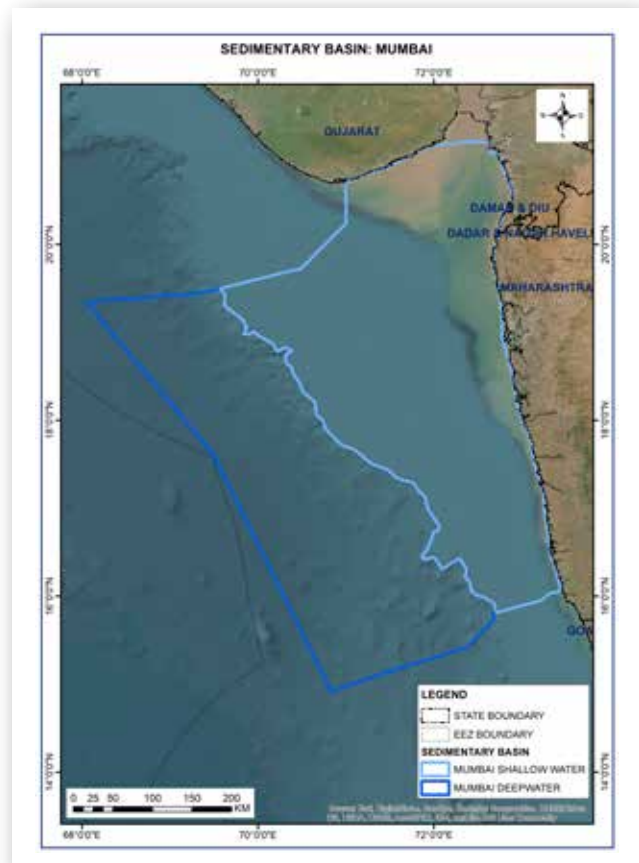
discovered inplace, potential to be produced at an optimum level.



Source: DGH Internal

Mumbai basin is exclusively offshore and it is located along the West Coast of Indian peninsula. The basin is the most prolific petroliferous provinces of India, contributing nearly half of oil and gas production of the country annually.

The deepwater part of the basin is not enough explored and opportunity lies to chase the basinward extension of prospective plays (Paleocene and Eocene). Similarly, Mesozoic plays lying below the Deccan basalts are still elusive in the basin, hence sub-basalt exploration for Mesozoic play remains an opportunity. The northerly located Saurashtra basin and southerly Kerala-Konkan basin have Mesozoic sequences identified and discovered.



Source: DGH Internal

Commercial hydrocarbon occurrences spread over the Tertiary stratigraphic interval ranging from the oldest sediments of Paleogene to the youngest sediments of Plio-Pleistocene. The hydrocarbons are mostly thermogenic, however the basin has witnessed discovery of biogenic gas within shallow plays.

Deepwater areas have a very few wells drilled. Deeper sequences, including Paleocene-to-Eocene are the future targets of exploration, particularly in Tapti-Daman area.

Both thermogenic and biogenic petroleum systems exist with varying TOC in the range of 0.9-12%. Results of petroleum system modelling suggest that areas around Bombay High hold



an opportunity for rim exploration of Carbonates of Bassein, Alibag, Mukta Formation; Panna plays in Deep Continental Shelf (DCS) and Paleocene-to-Miocene plays in North & North-

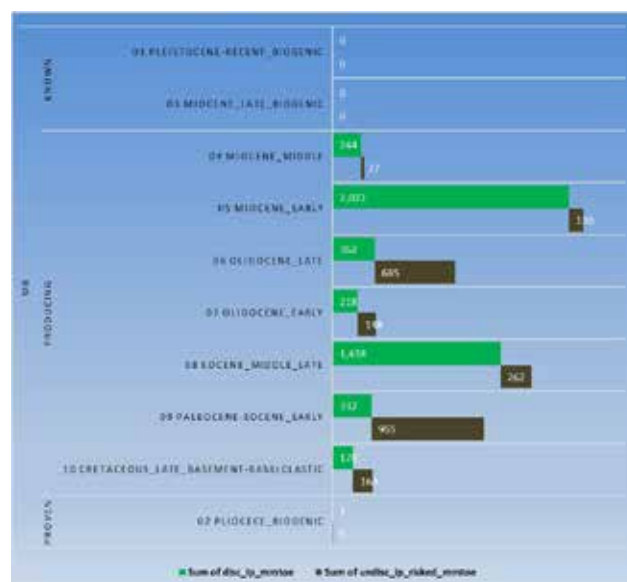
Western part of Mumbai High due to potential source charging from within Saurashtra Low.

Hydrocarbon prospectivity and Basin maturity:

In the basin, 7 thermogenic plays are identified within Basement and Tertiary. Besides, 3 biogenic plays are established in Late Miocene and Miocene, Pliocene and Pleistocene-Recent sequences. Petroleum system was modelled in 3D basis adequate datasets.

Mumbai Offshore basin has a total hydrocarbon inplace of 7,171 MMTOE. This includes discovered inplace of 4,795 MMTOE and undiscovered risked inplace of 2,376 MMTOE.

The discovered in-place is under commercial production. The basin has 33.1% of total inplace, potential to be explored and discovered.



Source: DGH Internal

Discoveries and Development:

2 discoveries were notified during the year under OALP regime in Shallow water. 3 field development plans were reviewed during the year under DSF(2) and NELP(1) regime in Shallow water.

Overview of producing fields:

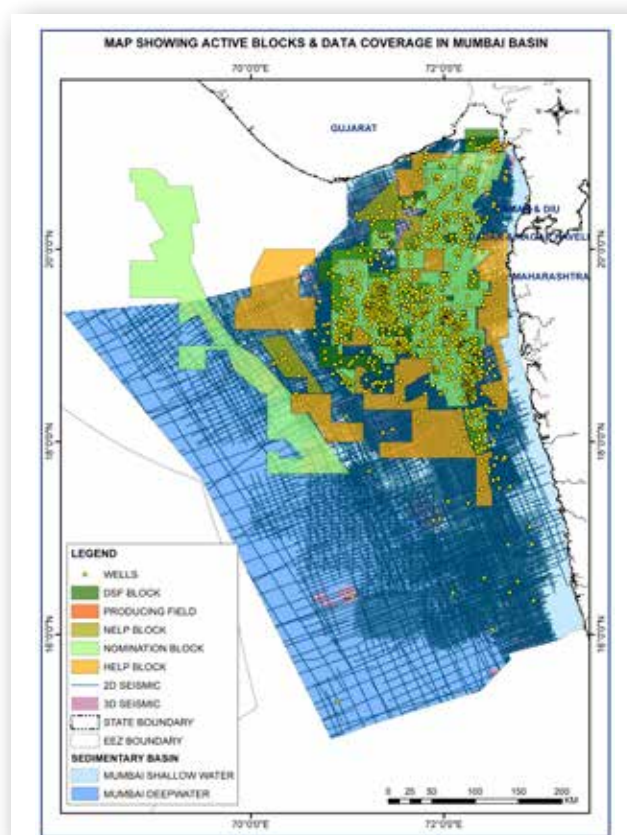
Commercial production in Shallow water sub-basin commenced in 1976. Major producing fields with cumulative production in parenthesis are namely Mumbai High (534 MMT, 191 BCM), Neelam & Heera (123 MMT, 0.096 BCM), Bassein & Satellite (103 MMT, 368 BCM). The sub-basin has 26 fields with 1,742 wells. The maximum flow rates achieved by any field on record in 2023-24 are, Oil 130,000 BOPD and Gas 10 MMSCMD.

Basin datasets, studies and opportunities:

As of 31.03.2024, NDR has archived data of 805,764 LKM 2D seismic, 208,050 SKM 3D seismic and 4,787 wells.

Under various campaigns by GoI, geophysical data were acquired in offshore area.

The basin was part of 46,453 LKM West Coast EEZ 2D seismic survey.



Source: DGH Internal



Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Shallow water	118,389	118,389 (100%)	Nomination: 26,279; Fields: 209; NELP: 1,961; OALP: 21,096; DSF: 7,336
Deepwater	93,611	93,611 (100%)	Nomination: 8,588; OALP: 147

The basin occupies an area of 212,000 sq km. It has been appraised to the extent of 212,000 sq km. (100%). The active area under operation across regime(s) stands at 65,616 sq. km.

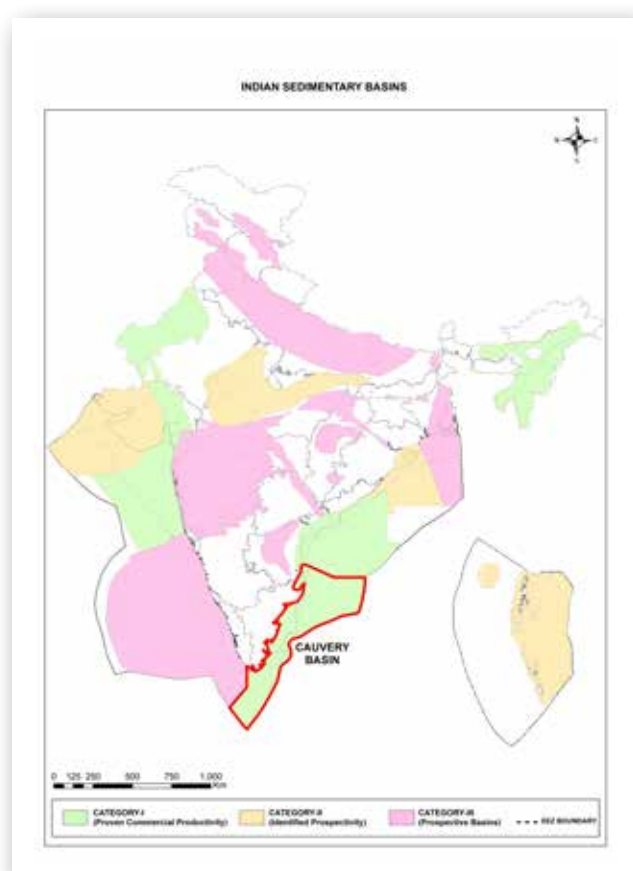
Current Bidding Opportunities:

Shallow water: 4 OALP blocks with 23,655 sq km area and 2 DSF blocks with 677 sq km area

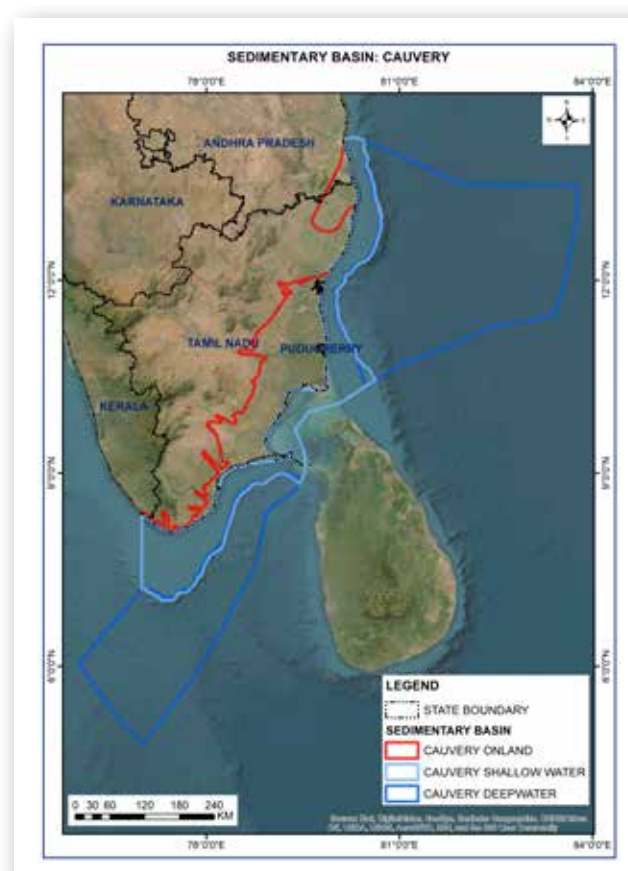
3. CAUVERY BASIN

Cauvery is a Category I basin, implying that the basin has significant commercial discovered inplace, potential to be produced

at an optimum level. The geographical area of the basin partially overlaps with the state(s) of Andhra Pradesh, Kerala, Puducherry and Tamil Nadu.



Source: DGH Internal



Source: DGH Internal



The basin is situated southerly along the east coast of Indian peninsula. Basin has significant production from Mesozoic and Basement. Ultradeep exploration opportunity is envisaged in undrilled areas in the northeast and southern part towards Gulf of Mannar.

Commercial hydrocarbon occurrences, besides basement, are encountered in wide stratigraphic sequences with the oldest sediments of Jurassic. Several oil and gas fields have been discovered with structural, stratigraphic and strati-structural entrapment conditions.

The basin hosts thick pile of sediments of the order of 8,000m, ranging from Late Jurassic. The onland part is mostly covered by the alluvium deposited by the major river system of Cauvery

and several stratigraphic sequences of Upper Gondwanas have cropped out along the basin margin areas.

Mapping of deeper plays, including Basement and facies propagation of Pre-Albian sequences are the focus area of exploration.

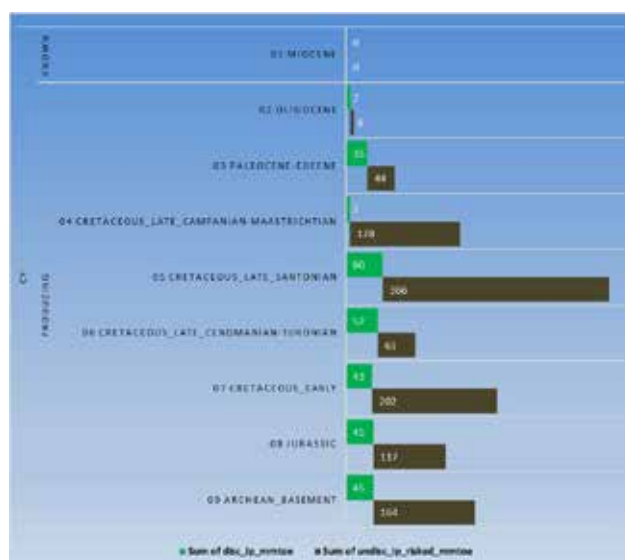
Good quality source rocks are present within Syn-rift (Jurassic & Early Cretaceous Shale) and Post-rift (Late Cretaceous, Eocene, Oligocene and Miocene shale) sequences with good TOC >1% and Organic matter (OM) is Type II + III. Basement Play alongwith Jurassic and Early Cretaceous plays are prospective. Gulf of Mannar basin remains a focus area in view of recent discoveries in Sri Lankan waters.

Hydrocarbon prospectivity and Basin maturity:

In the basin, 9 plays are known within Basement, Jurassic, Cretaceous and Paleocene-to-Miocene. Petroleum system was modelled in 3D basis adequate datasets.

Cauvery basin has a total hydrocarbon in-place of 1,432 MMTOE. This includes discovered in-place of 294 MMTOE and undiscovered risked in-place of 1,138 MMTOE.

The discovered in-place is under commercial production. The basin has 79.5% of total inplace, potential to be explored and discovered.



Source: DGH Internal

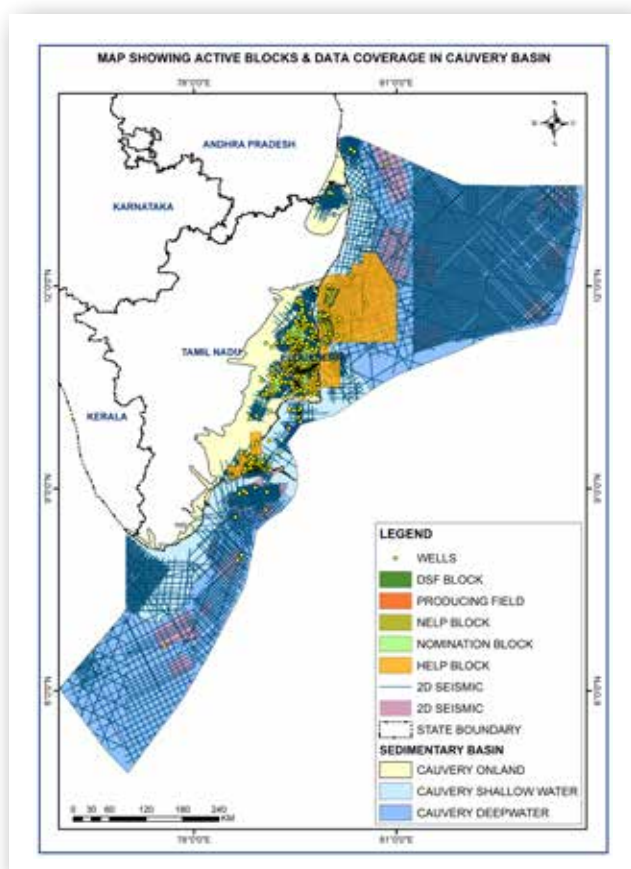
Overview of producing fields:

Commercial production in Onland sub-basin commenced in 1986. Major producing fields with cumulative production in parenthesis are namely Narimanam (3.5 MMT, 1 BCM), Kanjirangudi (4.5 BCM), Periyapattinam (4 BCM), Kuthalam (0.5 MMT, 3.5 BCM), Kamalapuram (2 MMT, 1 BCM), Pundi (1 MMT), CY-ONN-2002/2 (1 MMT). The sub-basin has 26 fields with 241 wells. The maximum flow rates achieved by any field on record in 2023-24 are, Oil 1,400 BOPD and Gas 1 MMSCMD.

Commercial production in Shallow water sub-basin commenced in 1997. Major field with cumulative production in parenthesis are namely PY-3 (3 MMT) from which re-commencement in expected by Q4 2024-25. The sub-basin has 2 fields with 2 wells. Currently producing field PY-1 field with average condensate of 9 BCPD with 0.02 MMSCMD gas, while PY-3 field produced upto 10,000 BOPD in 1998.



Basin datasets, studies and opportunities:



Source: DGH Internal

As of 31.03.2024, NDR has archived data of 251,404 LKM 2D seismic, 102,027 SKM 3D seismic and 861 wells.

Under various campaigns by GoI, geophysical data were acquired, initially in onland basins and later, extended to offshore areas.

Under Air-borne Gravity-Gradiometry (AGG) survey, 12,295 FLKM data were acquired in inaccessible and operationally challenging areas where seismic survey under NSP could not be conducted.

The offshore was part of 8,234 LKM East Coast EEZ 2D seismic survey.



Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	37,825	25,143 (66%)	Nomination: 4,016; Fields: 267; OALP: 1,740; DSF: 407
Shallow water	43,723	43,723 (100%)	Nomination: 11; Fields: 157; NELP: 761; OALP: 4,250; DSF: 76
Deepwater	158,452	158,452 (100%)	NELP: 97; OALP: 11,965

The basin occupies an area of 240,000 sq km. It has been appraised to the extent of 227,318 sq km. (95%). The active area under operation across regime(s) stands at 23,747 sq. km.

Current Bidding Opportunities:

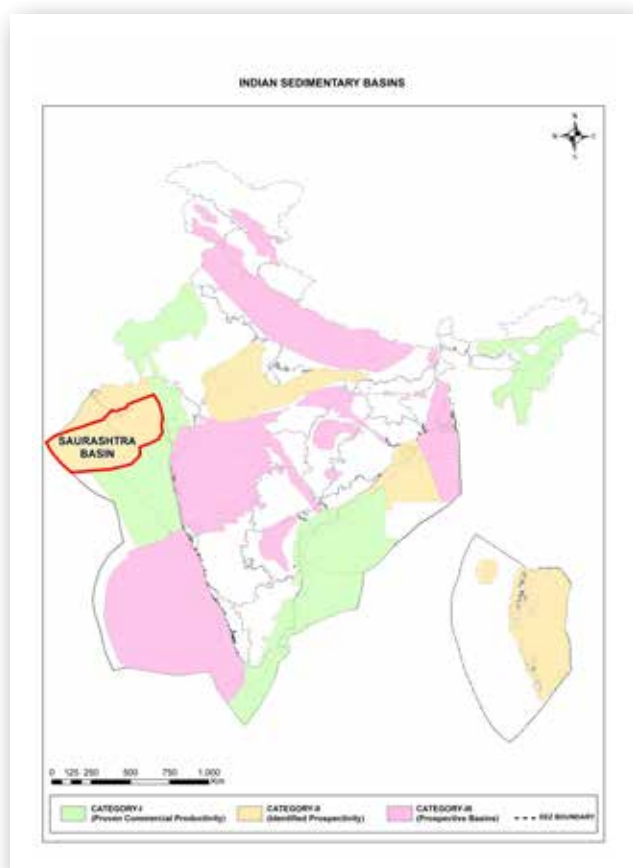
Deepwater:

5 OALP blocks with 42,476 sq km area



4. SAURASHTRA BASIN

Saurashtra is a Category II basin, implying that the basin has sub-commercial discovered inplace, potential to be commercially produced.



Source: DGH Internal

The basin is geologically contiguous with Kutch basin and separated by the Saurashtra Arch in the offshore part, which trends N/NW- S/SE direction. The basin has presence of prospective plays of Middle Jurassic to Early Cretaceous with significant potential of sub-basalt Mesozoic plays. There has been a gas discovery in Early Cretaceous reservoirs at 4,500m depth, below 2,500m thick weathered basalts. The northerly located proven Tertiary Plays of Kutch basin is extended into this basin.

Major part of Saurashtra mainland is covered with Deccan Trap basalts with thin veneer of Miocene and younger sediments, exposed along Porbandar coast. The Cenozoic sediments

Onland sub-basin partially overlaps with the state(s) of Daman & Diu and Gujarat.



Source: DGH Internal

have been encountered in the wells drilled in the offshore Saurashtra basin. In offshore, the basin lies north of Mumbai Offshore Basin, while the onland part borders with Cambay Basin on its eastern flanks. The deeper offshore Saurashtra borders with the Indus fan.

Two wells have been drilled in the onland part of the basin viz., Lodhika-1 and Dhandhuka-1. The granitic basement has been encountered in well Dhandhuka-1 near to the western margin fault. Also, basalt/dolerite dykes and sills are frequently present in the sandstone beds of Wadhwan and Dhrangadhra Formation in these two wells.

The basin was built with Pre-Cambrian basement overlain by Mesozoic sediments followed by Deccan traps. A thin cover of Neogene and Quaternary sediments occurs at the top. The drainage of Saurashtra shows a radial pattern from the central highland.

The source rocks maturity of Cretaceous is poor and it remains immature in onland.



Sub-basalt imaging, variable basalt thickness and sub-optimal onland seismic data are some areas of focus for exploring Cretaceous plays.

Late Jurassic and Early Cretaceous shale with

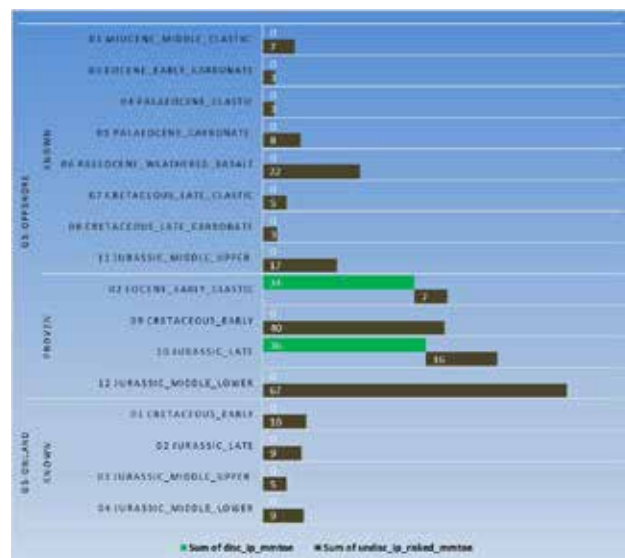
TOC- 0.80% is expected to be the main source rock for clastic and carbonate reservoirs. Low frequency 2D seismic API could add to improved sub-trappean imaging.

Hydrocarbon prospectivity and Basin maturity:

In the basin, 16 plays are located within Middle Jurassic-to-Early Cretaceous in Onland and Middle Jurassic-to-Trip-to-Middle Miocene in Offshore. Petroleum system was modelled in 3D where datasets were adequate and Aerial Yield method was used where data were limited.

Onland sub-basin has a total hydrocarbon in-place of 33 MMTOE and this is entirely undiscovered risked inplace. The basin has 100% of total inplace, potential to be explored and discovered.

Offshore sub-basin has a total hydrocarbon in-place of 267 MMTOE. This includes discovered in-place of 70 MMTOE and undiscovered risked in-place of 197 MMTOE. The discovered in-place is subject to commercial development. The basin has 73.8% of total inplace, potential to be explored and discovered.



Source: DGH Internal

Discoveries and Development:

1 field development plan was reviewed during the year under NELP regime in Shallow water.

Basin datasets, studies and opportunities:

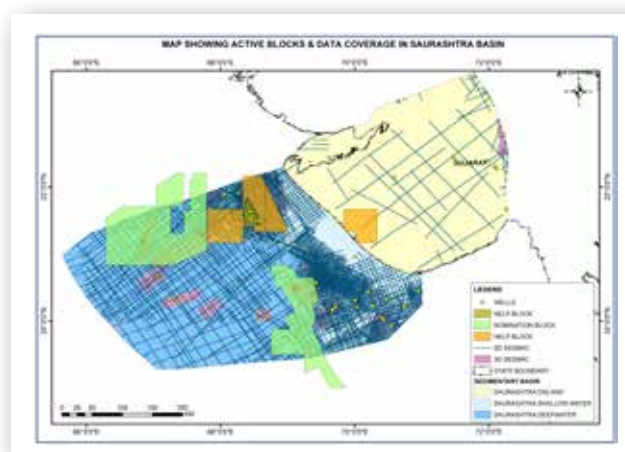
As of 31.03.2024, NDR has archived data of 196,462 LKM 2D seismic, 29,624 SKM 3D seismic and 38 wells.

Under various campaigns by GoI, geophysical data were acquired, initially in onland basins and later, extended to offshore areas. Under National Seismic Programme (NSP), 2,306 LKM 2D seismic data were acquired. In another initiative, titled Mission Anveshan 660 LKM 2D seismic are planned as an in-fill data acquisition campaign of NSP.

The offshore was part of 46,453 LKM West Coast EEZ 2D seismic survey.

The basin has been identified for drilling of one stratigraphic well under the GoI-approved plan.

Pandit Deendayal Energy University(PDEU), Gandhinagar, India has carried out geo-scientific data analysis as a part of basin-scale research study.



Source: DGH Internal



Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	75,076	24,992 (33%)	OALP: 1,285
Shallow water	42,617	39,992 (94%)	Nomination: 601; NELP: 552; OALP: 7,478
Deepwater	76,421	76,421 (100%)	Nomination: 19,850; OALP: 1,502

The basin occupies an area of 194,114 sq km. It has been appraised to the extent of 141,405 sq km. (73%). The active area under operation across regime(s) stands at 31,268 sq. km.

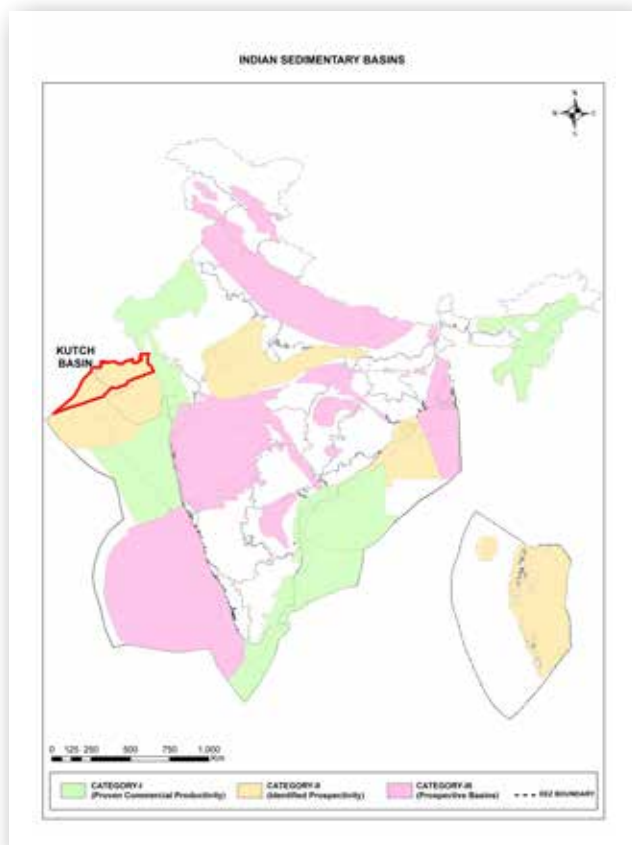
Current Bidding Opportunities:

Onland	3 OALP blocks with 8,710 sq km area
Shallow water:	5 OALP blocks with 26,076 sq km area
Deepwater	3 OALP blocks with 25,205 sq km area

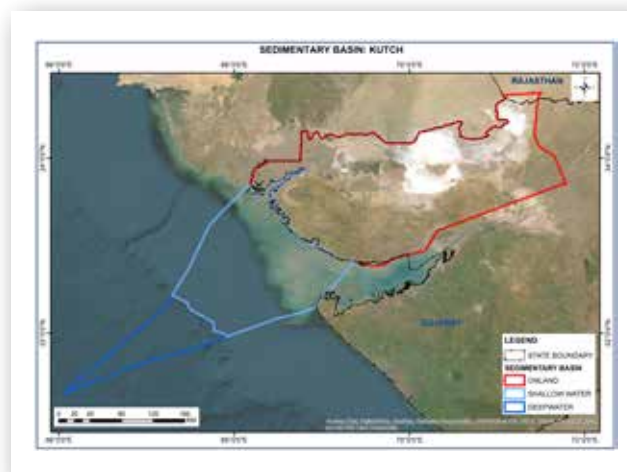
5. KUTCH BASIN

Kutch is a Category II basin, implying that the basin has sub-commercial discovered inplace, potential to be commercially produced.

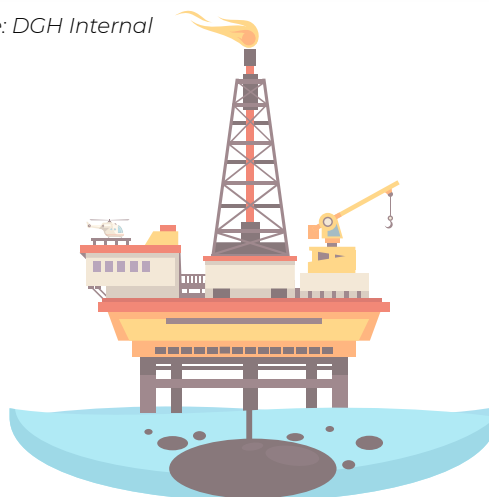
Onland sub-basin partially overlaps with the state(s) of Gujarat and Rajasthan.



Source: DGH Internal



Source: DGH Internal



The geologically contiguous Kutch and Saurashtra basins are separated by the Saurashtra Arch in the offshore part. The Mesozoic sediments ranging in age from Middle Jurassic to Cretaceous are exposed in the mainland Kutch and encountered in the wells drilled in offshore. The Cenozoic strata are also exposed in the southwestern part of Kutch mainland and encountered in the offshore wells.

The basin has significant opportunity to consolidate discovered resources of Tertiary Plays. Being analogous to Saurashtra Basin, opportunity also lies for exploring Mesozoic Plays.

Exploration in the basin started in the early 1960's with the first offshore seismic survey conducted during 1964-65.

Stratigraphically, the northern limit of Kutch outcrops is continued beyond Indo-Pakistan border. In the offshore of Kutch and further south, the basin is contiguous with Saurashtra offshore basin.

Middle Miocene and Early Eocene are the main plays and additional hydrocarbons are

established in Paleocene, Late Cretaceous, and Early Cretaceous in the basin. All the hydrocarbon accumulations are related to mild inversion tectonics involving Mesozoic and Tertiary sections.

Improved sub-basalt imaging is a major push towards assessment of Mesozoic sequences. Basin area is under revision to 69,986 sq km, subject to a detailed review during the next hydrocarbon resource assessment study.

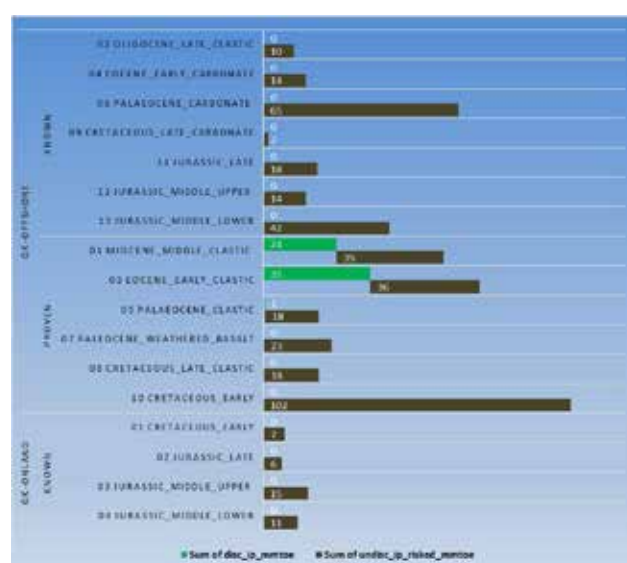
Petroleum system modeling suggests that Jhuran (HI: 203-245 mg HC/g TOC) and Jumara (HI: 76-195 mg HC/g TOC) have fair to good potential to produce hydrocarbon while Bhuj Formation is having best hydrocarbon generation potential (HI: 196-264 mg HC/g TOC). 2D modelling suggests that the source rock maturity of Cretaceous is poor and remains immature in onland. It is inferred that the hydrocarbon generation capacity of Jurassic source rocks is higher than the Cretaceous source rocks in onland. Acquisition of close grid 2D data followed by detailed 3D campaign could add to better mapping and understanding of entrapment model and accumulation pattern.

Hydrocarbon prospectivity and Basin maturity:

In the basin, 17 plays are identified within Middle Jurassic-to-Cretaceous in Onland and Middle Jurassic-to-Trip-to-Middle Miocene in Offshore. Petroleum system was modelled in 3D where datasets were adequate and Aerial Yield method was used where data were limited.

Onland sub-basin has a total hydrocarbon in-place of 39 MMTOE and this is entirely undiscovered risked inplace. The basin has 100% of total inplace, potential to be explored and discovered.

Offshore sub-basin has a total hydrocarbon in-place of 457 MMTOE. This includes discovered in-place of 60 MMTOE and undiscovered risked in-place of 397 MMTOE. The discovered in-place is subject to commercial development. The basin has 86.9% of total inplace, potential to be explored and discovered.



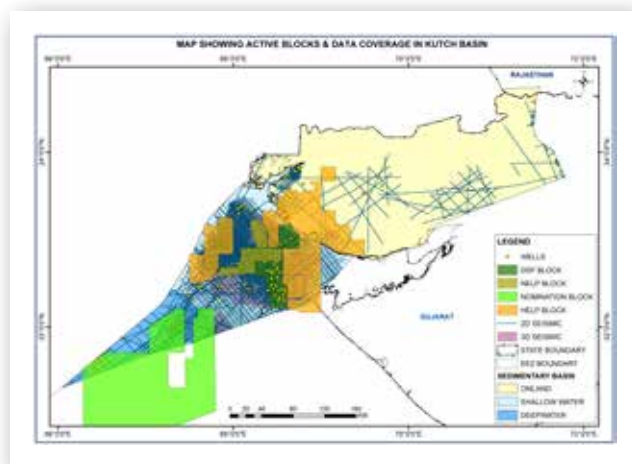
Source: DGH Internal



Discoveries and Development:

1 field development plan was reviewed during the year under DSF regime in Shallow water.

Basin datasets, studies and opportunities:



Source: DGH Internal

As of 31.03.2024, NDR has archived data of 69,367 LKM 2D seismic, 76,105 SKM 3D seismic and 79 wells.

Under various campaigns by GoI, geophysical data were acquired, initially in onland basins and later, extended to offshore areas. Under National Seismic Programme (NSP), 1,809 LKM 2D seismic data were acquired.

The offshore was part of 46,453 LKM West Coast EEZ 2D seismic survey.

Pandit Deendayal Energy University (PDEU), Gandhinagar, India has carried out geo-scientific data analysis as a part of basin-scale research study.

Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	42,186	23,513 (56%)	OALP: 4,546
Shallow water	20,500	20,500 (100%)	Nomination: 107; NELP: 1,879; OALP: 6,852; DSF: 2,092
Deepwater	7,300	7,300 (100%)	Nomination: 3,779

The basin occupies an area of 69,986 sq km. It has been appraised to the extent of 51,313 sq km. (73%). The active area under operation across regime(s) stands at 19,255 sq. km.

Current Bidding Opportunities:

Shallow water:

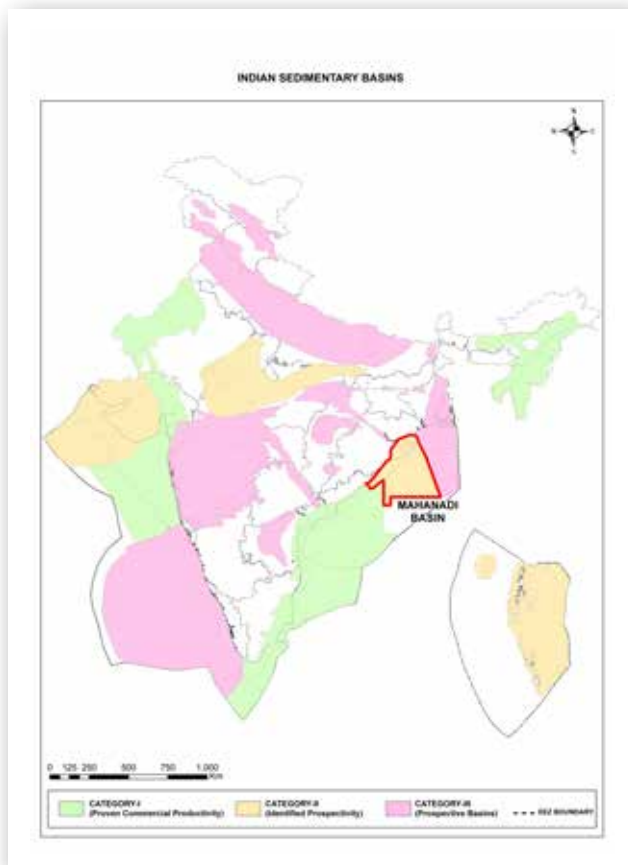
1 OALP block with 3,165 sq km area



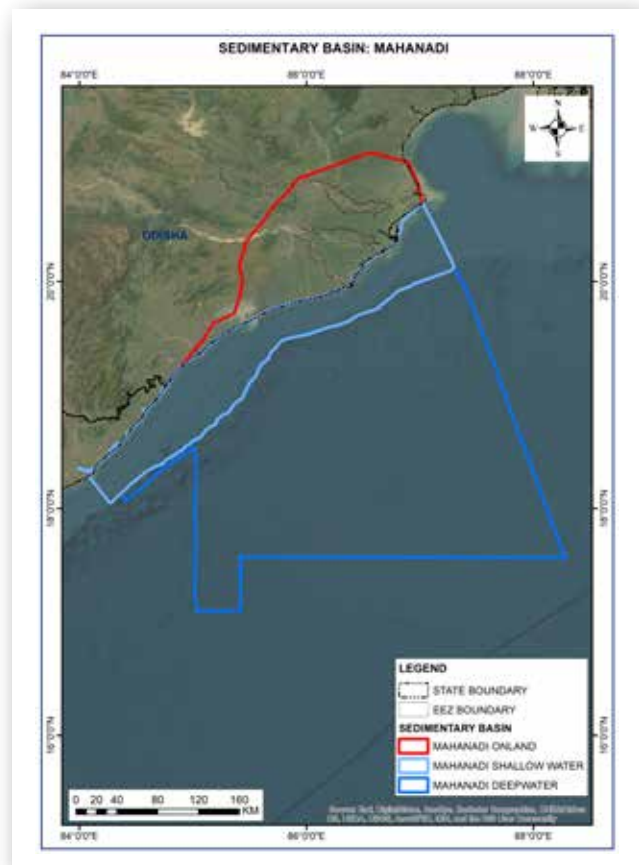
6. MAHANADI BASIN

Mahanadi is a Category II basin, implying that the basin has sub-commercial discovered inplace, potential to be commercially produced.

Onland sub-basin partially overlaps with the state of Odisha.



Source: DGH Internal



Source: DGH Internal

The basin is situated along the East Coast of Indian peninsula. Mahanadi basin is significantly appraised with strong analogy with the easterly located Bengal offshore that has numerous small-to-medium discoveries. Deepwater is not enough explored, however discovered Miocene play occurs as discrete and stacked reservoirs, which may require consolidation. Enhanced exploration opportunity exists for the prospective Pliocene plays.

Hydrocarbon occurrences spread over the Tertiary stratigraphic sequences ranging from the oldest sediments of Paleogene to the youngest sediments of Miocene-Pliocene. Several biogenic gas fields have been discovered with strati-structural entrapment conditions.

Though hydrocarbon accumulations often indicate charging from in-situ shallower biogenic source sequences, there are instances where thermogenic accumulations have been established.

The basin hosts a thick pile of sediments, mainly ranging from Early Cretaceous to Recent. The basin's onland part is mostly covered by the Mesozoic sediments which is underlying the Miocene sediments, deposited by the major river system of Mahanadi. Stratigraphic sequences including Gondwanas are reported in some small rift grabens.

The basin has the close analogy with Cretaceous sequence of KG basin.



Petroleum system model results show prospective trend towards northeast part of offshore adjoining Bengal offshore. High resolution seismic acquisition for delineating deeper plays and supporting pore-pressure study in high pressure area are the key focus.

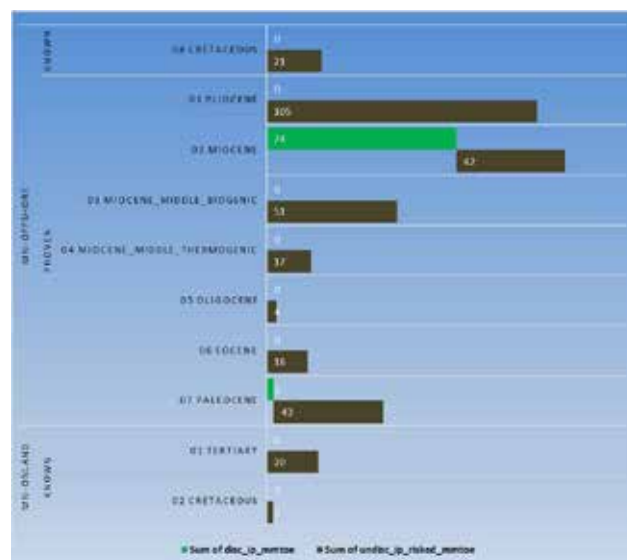
Shale-coal couplet of Early Cretaceous-Late Jurassic in the syn rift grabens is the likely kitchen with TOC up-to 9.5%, followed by Miocene post-rift marine shales having TOC 0.99-6.81%.

Hydrocarbon prospectivity and Basin maturity:

In the basin, 10 plays exist within Cretaceous-Tertiary. Petroleum system was modelled in 3D basis adequate datasets.

Onland sub-basin has a total hydrocarbon in-place of 22 MMTOE and this is entirely undiscovered risked inplace. The basin has 100% of total inplace, potential to be explored and discovered.

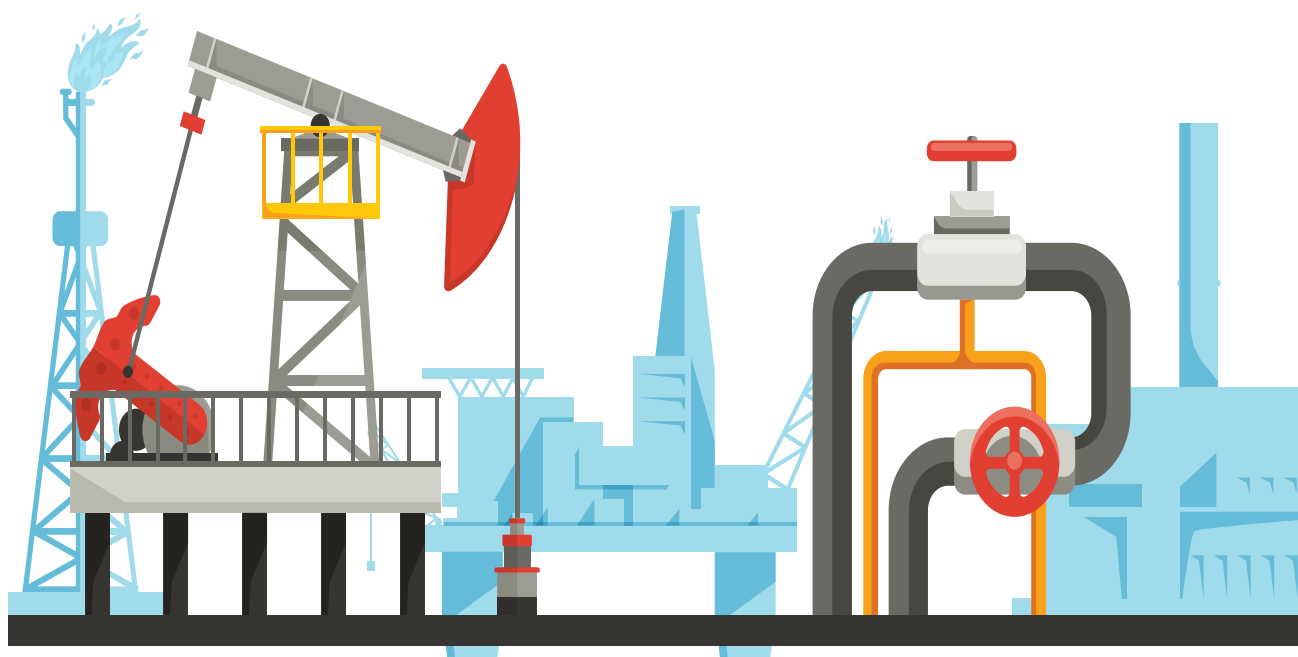
Offshore sub-basin has a total hydrocarbon in-place of 375 MMTOE. This includes discovered in-place of 77 MMTOE and undiscovered risked in-place of 298 MMTOE. The discovered in-place is subject to commercial development. The basin has 79.5% of total inplace, potential to be explored and discovered.



Source: DGH Internal

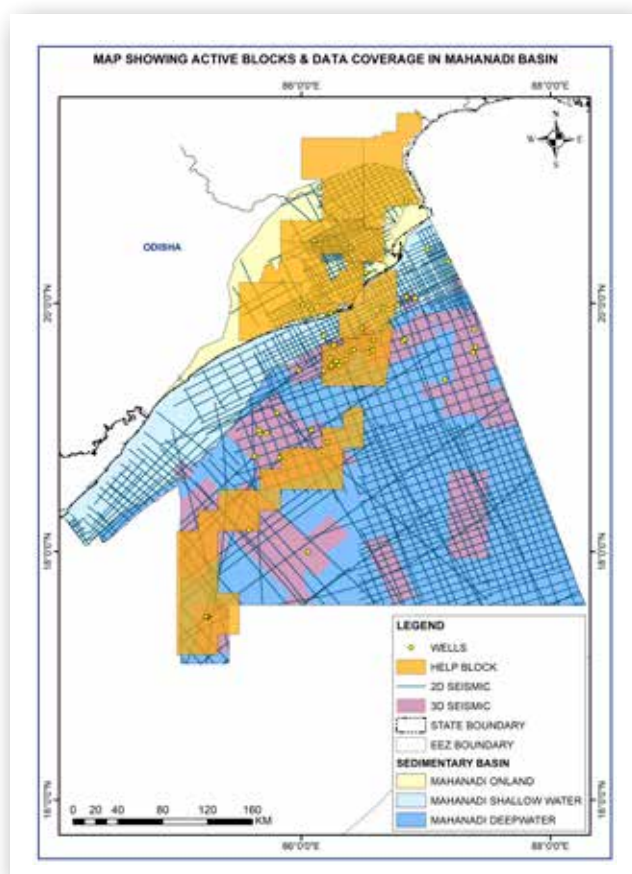
Discoveries and Development:

2 discoveries were notified during the year under OALP regime in Deepwater.



Source: DGH Internal

Basin datasets, studies and opportunities:



Source: DGH Internal

As of 31.03.2024, NDR has archived data of 132,768 LKM 2D seismic, 63,796 SKM 3D seismic and 48 wells.

Under various campaigns by GoI, geophysical data were acquired, initially in onland basins and later, extended to offshore areas.

Under National Seismic Programme (NSP), 2,481 LKM 2D seismic data were acquired.

The offshore was part of 8,234 LKM East Coast EEZ 2D seismic survey.

The basin has been identified for drilling of one stratigraphic well under the GoI-approved plan.

The basin is under active study by University of Houston, Texas, USA.

Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	15,500	15,500 (100%)	OALP: 10,957
Shallow water	14,211	14,211 (100%)	OALP: 2,151
Deepwater	69,789	69,789 (100%)	OALP: 11,470

The basin occupies an area of 99,500 sq km. It has been appraised to the extent of 99,500 sq km. (100%). The active area under operation across regime(s) stands at 24,578 sq. km.

Current Bidding Opportunities:

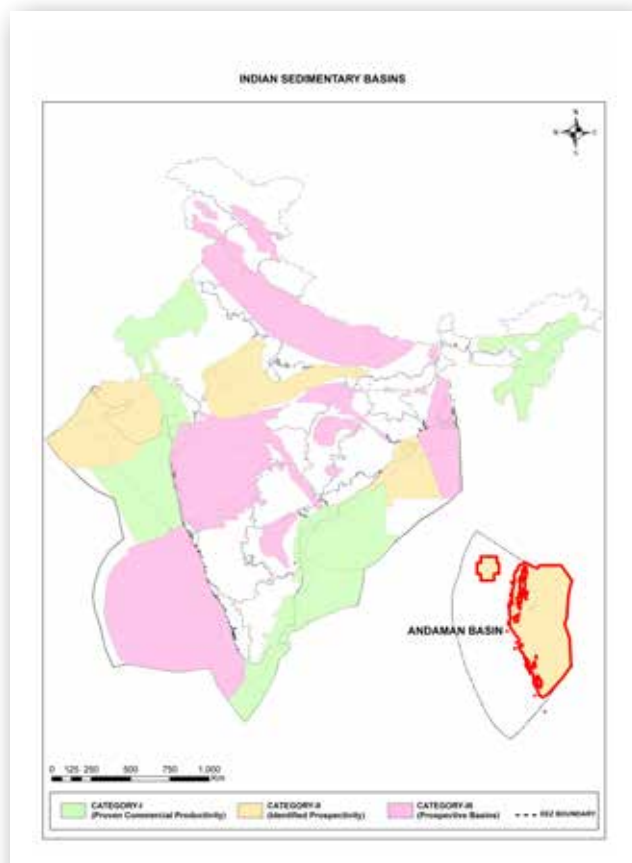
Deepwater:

6 OALP blocks with 51,967 sq km area



7. ANDAMAN BASIN

Andaman is a Category II basin, implying that the basin has sub-commercial discovered inplace, potential to be commercially produced.

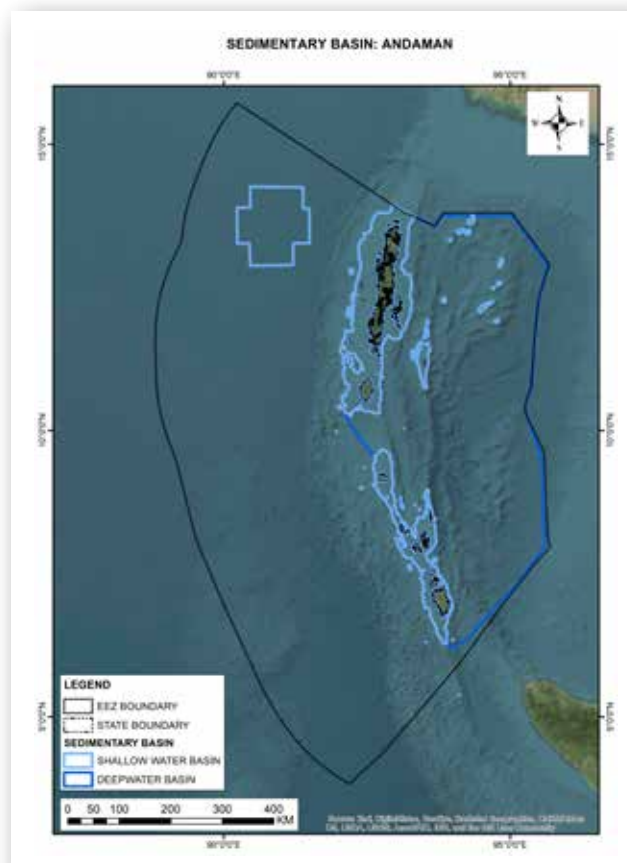


Source: DGH Internal

Andaman is an offshore basin, characterized primarily by siliciclastic shallow to deepwater sediments. Fore-arc has a significant gas discovery in Miocene, analogous to producing reservoirs of Myanmar and Indonesia gas fields. Gas hydrate has also been established in Fore-arc. Back-arc area has sediments with prominent entrapment features on seismic.

Hydrocarbon occurrences are reported in Mid Miocene Play, geographically present in East Andaman part. Potential future gas discoveries are considered mainly within structural entrapment conditions. The hydrocarbon accumulations often indicate charging from deeper source sequence.

The basin is envisaged to host sediments, ranging from Paleocene to Recent.



Source: DGH Internal

Geochemical data and structural complexity are key areas of focus. Southeastern area of East Andaman is considered prospective due to source rock maturity. Basin area is under revision to 248,908 sq km, subject to a detail review during the next hydrocarbon resource assessment study.

A string of gas and condensate discoveries in the syn-rift Oligocene clastic sequences in North Sumatra and Irrawaddy-Margui basin like Timpan-1, Tangkulo-1 and Layaran-1, suggests that in addition to post-rift thermogenic and biogenic plays in east Andaman basin, syn-rift thermogenic petroleum system is functional but are yet to be delineated. Thick deepwater shales are the main source and seal, reefal carbonates also act as minor source to shallow marine syn-rift and post-rift sands and limestones with secondary porosity.

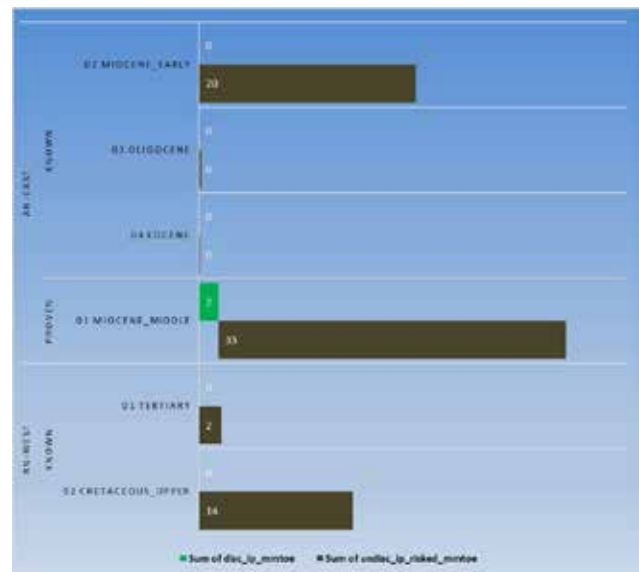


Hydrocarbon prospectivity and Basin maturity:

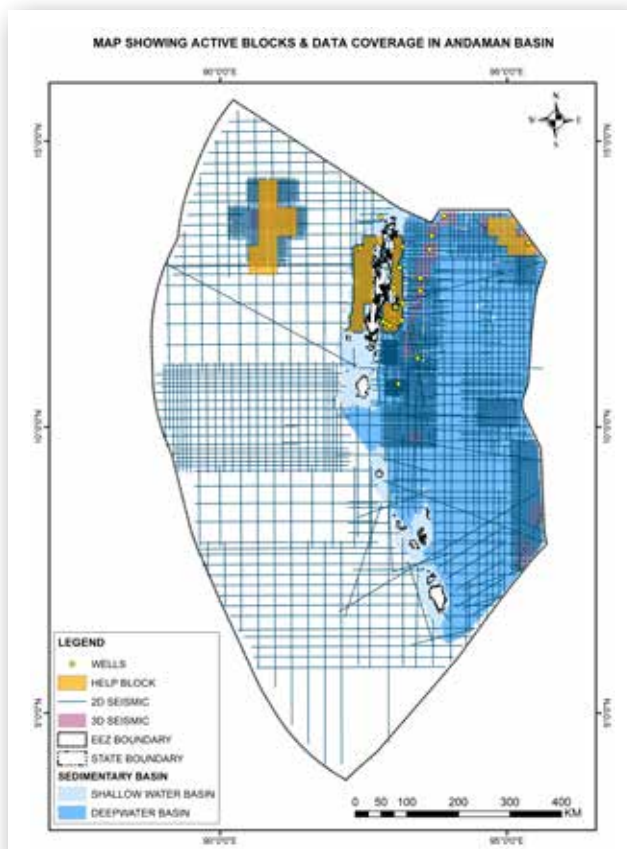
In the basin, 6 plays are identified within Eocene-to-Middle Miocene in East Andaman and Cretaceous-Tertiary in West Andaman. Petroleum system was modelled in 3D where datasets were adequate and Aerial Yield method was used where data were limited. Though biogenic system was envisaged, it was not modelled.

Offshore East sub-basin has a total hydrocarbon inplace of 55 MMTOE. This includes discovered in-place of 2 MMTOE and undiscovered risked in-place of 53 MMTOE. The discovered in-place is subject to commercial development. The basin has 96.4% of total inplace, potential to be explored and discovered.

Offshore West sub-basin has a total hydrocarbon inplace of 16 MMTOE and this is entirely undiscovered risked in-place. The basin has 100% of total inplace, potential to be explored and discovered.



Source: DGH Internal



Source: DGH Internal

Basin datasets, studies and opportunities:

As of 31.03.2024, NDR has archived data of 484,374 LKM 2D seismic, 32,950 SKM 3D seismic and 22 wells.

Under various campaigns by GoI, geophysical data were acquired, initially in onland basins and later, extended to offshore areas.

Under National Seismic Programme (NSP), 264 LKM 2D seismic data were acquired. 22,564 LKM 2D seismic data were also acquired in Andaman basin under extended NSP into offshore area.

Under EEZ survey programme, 24,853 LKM 2D seismic data were additionally acquired.

The basin has been identified for drilling of one stratigraphic well under the GoI-approved plan.

The basin is under active study by University of Houston, Texas, USA.



Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Shallow water	41,064	9,675 (24%)	OALP: 9,075
Deepwater West	14,211	16,862 (100%)	OALP: 8,030
Deepwater East	190,982	190,982 (100%)	OALP: 3,958

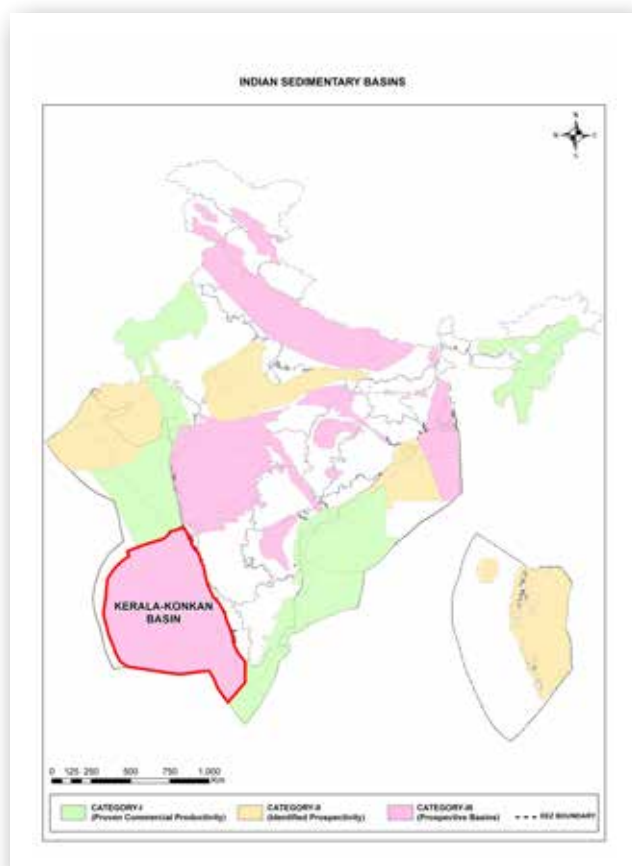
The basin occupies an area of 248,908 sq km. It has been appraised to the extent of 217,519 sq km. (87%). The active area under operation across regime(s) stands at 21,063 sq. km.

Current Bidding Opportunities:

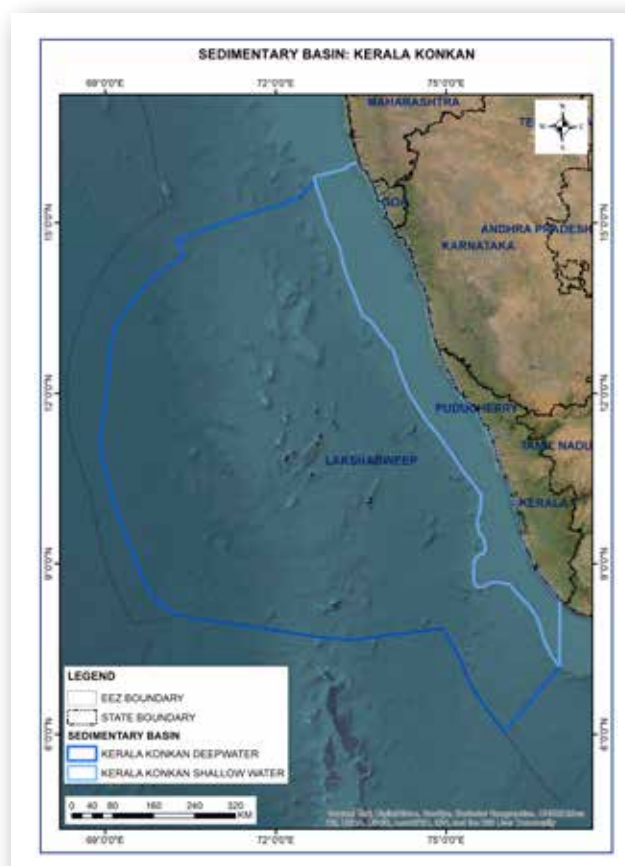
Deepwater East: 4 OALP blocks with 47,058 sq km area

8. KERALA-KONKAN (KK) BASIN

Kerala-Konkan (KK) is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery.



Source: DGH Internal



Source: DGH Internal



Kerala-Konkan Basin is characterized by carbonate-siliciclastic shallow to deepwater sediments. The basin covers mainly the offshore provinces with isolated fringes of Miocene and younger sediments in coastal onland area.

Deepest play is the Early Cretaceous and shallowest is the Oligo-Miocene.

The basin has the close analogy with Gulf of Mannar for Kerala sub-basin. Petroleum system model could be constructed based on corroborative datasets of broad-grid seismic and wells

Resources are entirely undiscovered and half of total resources envisaged in Late Cretaceous play below basalts.

Poor sub-basalt imaging can be addressed by long-offset seismic survey, magneto-telluric,

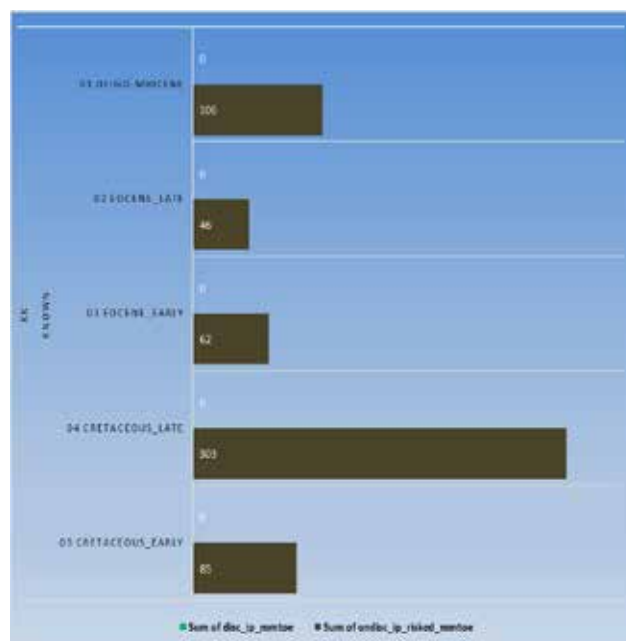
controlled source electromagnetic surveys. Shelfal areas around Cochin Low in Kerala sub-basin is the key focus area for exploration.

There exist multiple source rocks ranging from Late Cretaceous to Mid Miocene with TOC for Mesozoic is 0.52-1.47%, while, for the Tertiary sequences, it ranges from 0.13-16.83%. Cretaceous kerogen is expected to be Type-III while Type II/III is expected from Tertiary sequences. The reservoir rocks are both carbonates and clastics, spread over the entire sedimentary column. The petroleum system model has brought out Cochin low in the Kerala basin as the main kitchen area that has charged the surrounding areas. Understanding the Mesozoic sequence in the basin remains a challenge due to impoverished subsurface seismic imaging below thick basalt.

Hydrocarbon prospectivity and Basin maturity:

In the basin, 5 plays are located within Early Cretaceous to Miocene. Petroleum system was modelled in 3D basis adequate datasets.

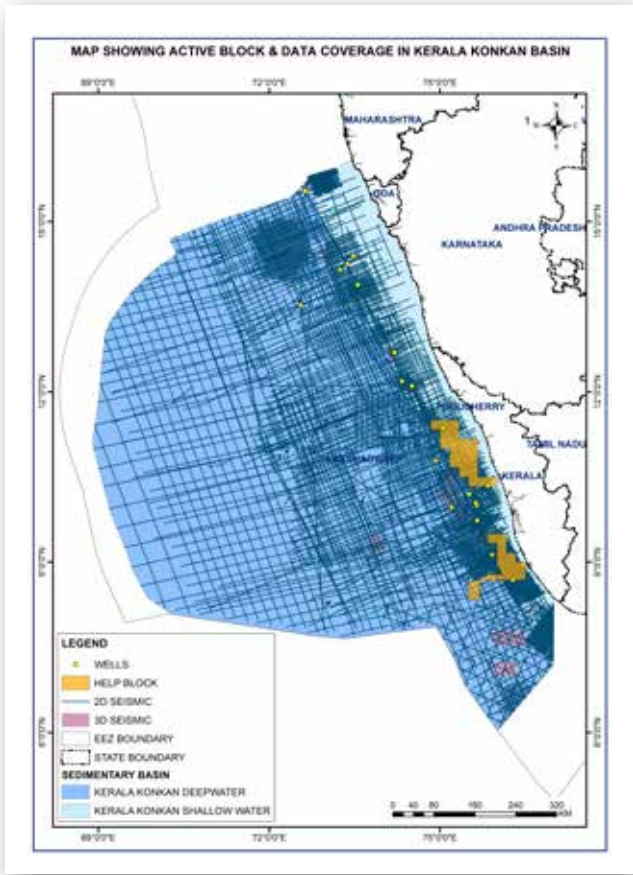
Kerala-Konkan (KK) basin has a total hydrocarbon in place of 602 MMTOE and this is entirely undiscovered risked in-place.



Source: DGH Internal



Basin datasets, studies and opportunities:



As of 31.03.2024, NDR has archived data of 518,412 LKM 2D seismic, 38,833 SKM 3D seismic and 20 wells.

Under various campaigns by GoI, geophysical data were acquired in offshore area.

The basin was also part of 46,453 LKM West Coast EEZ 2D seismic survey.

Indian Institute of Petroleum & Energy (IIPE), Visakhapatnam, India has carried out geo-scientific data analysis as a part of basin-scale research study.



Source: DGH Internal

Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Shallow water	90,380	90,380 (100%)	OALP: 10,543
Deepwater	489,620	489,620 (100%)	OALP: 807

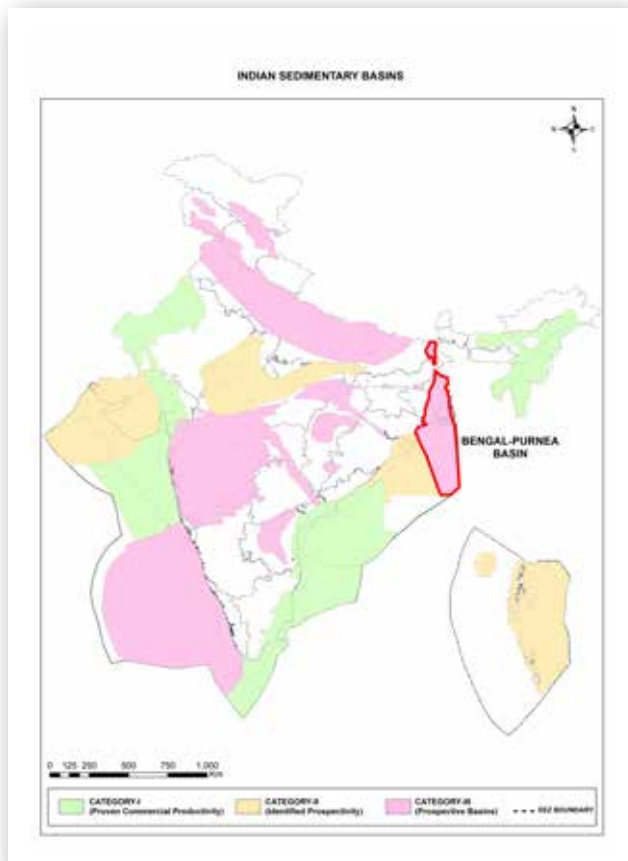
The basin occupies an area of 580,000 sq km. It has been appraised to the extent of 580,000 sq km. (100%). The active area under operation across regime(s) stands at 11,350 sq. km.



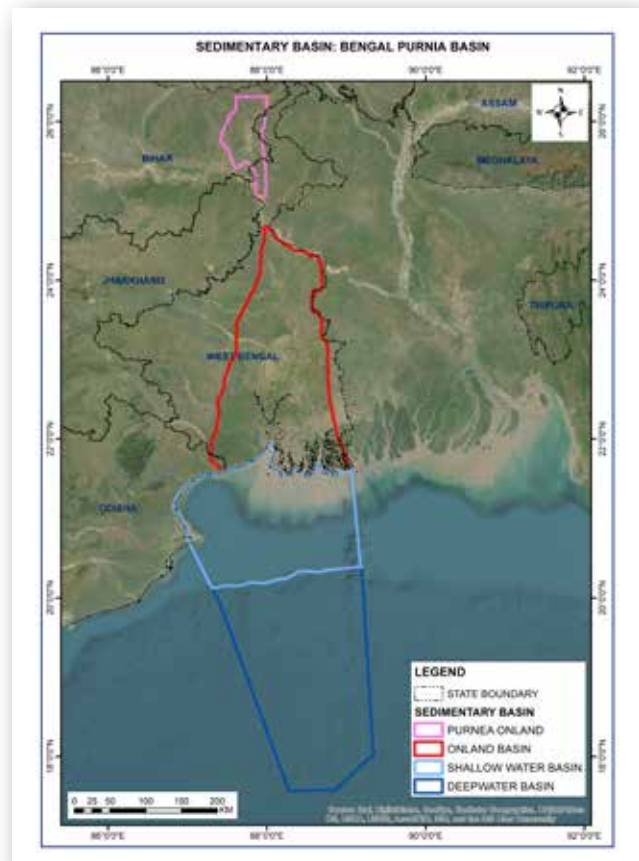
9. BENGAL-PURNEA BASIN

Bengal-Purnea is a Category III basin, implying that the basin has largely undiscovered inplace, that calls for intense exploration for a potential discovery.

Onland sub-basin partially overlaps with the state(s) of Odisha and West Bengal. Purnea sub-basin partially overlaps with the state(s) of Bihar and West Bengal.



Source: DGH Internal



Source: DGH Internal

Bengal-Purnea basin has three sub-basins namely Bengal onland, Bengal offshore and Purnea onland. The basin is situated along the East Coast of Indian peninsula. The onland sub-basin has established both oil and gas discoveries.

The offshore part of basin has two-third of potential lying in Middle Miocene play and six gas discoveries are notified. Occurrence of Channelized deposits associated to subtle structures in the east-central area can be significant exploration targets.

In the basin, some biogenic gas shows are reported from the Tertiary stratigraphic

interval ranging from the oldest sediments of Paleogene to the youngest sediments of Miocene-Pliocene complex, which are geographically distributed majorly over offshore areas.

This basin hosts a thick pile of sediments of 10,000 m and more, ranging from Permo-Triassic to Recent. The basin's onland part is mostly covered by the Mesozoic sediments, overlain by the thick Tertiary sediments comprising of Paleocene to Recent sediments, mainly deposited by the Ganga-Brahmaputra river system.



The basin has the close analogy with Gondwana sequence of KG basin. The hydrocarbon accumulations often indicate charging from in-situ shallower biogenic source sequences. The establishment of thermogenic plays (Miocene-Pliocene) in recent discoveries in Bengal onland point to potential deep-seated source rocks, that can also charge deeper plays.

Hinge zone of Bengal basin remains the exploration priority and the reservoir

characterization studies of channel facies are the thrust area.

In Purnea subbasin, multiple shale sequences within Tertiary sequence have good TOC to generate hydrocarbon. TOC ranging from 0.35-2.44 % is observed with Type II/III OM. While Gondwana sediments have Type-III OM with an average TOC 1.9%. Intra-formational sandstones from Permo-Triassic to Pliocene are expected to be part of the reservoir facies.

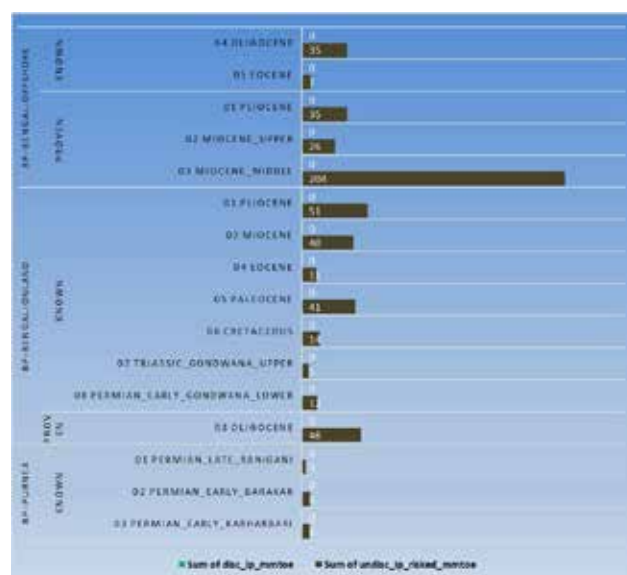
Hydrocarbon prospectivity and Basin maturity:

In the basin, 8 plays exist within Gondwana-Cretaceous-Tertiary in the Onland part. 5 plays are known within Eocene-Pliocene in Offshore part. 3 plays are identified within Gondwana (Karharbari-Barakar-Raniganj) of Purnea sub-basin. Petroleum system was modelled in 3D basis adequate datasets.

Onland sub-basin has a total hydrocarbon in-place of 220 MMTOE and this is largely undiscovered risked inplace.

Offshore sub-basin has a total hydrocarbon in-place of 307 MMTOE and this is entirely undiscovered risked in-place.

Purnea sub-basin has a total hydrocarbon in-place of 15 MMTOE and this is entirely undiscovered risked inplace.



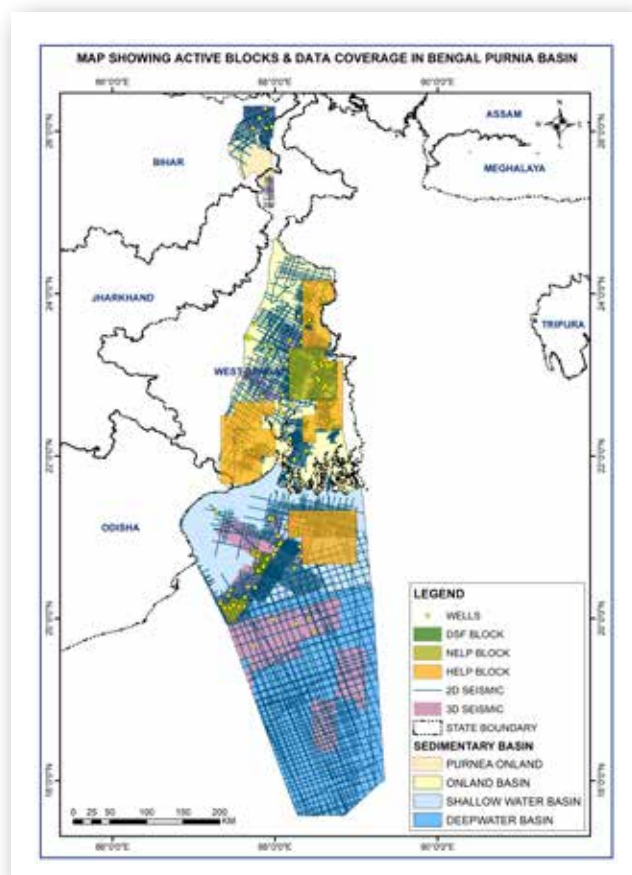
Source: DGH Internal

Overview of producing fields:

Commercial production in Bengal sub-basin commenced in 2020. The oil production started from Asokenagar-1 discovery subsequent to implementation of early development scheme in the block WB-ONN-2005/4.



Basin datasets, studies and opportunities:



Source: DGH Internal

As of 31.03.2024, NDR has archived data of 110,432 LKM 2D seismic, 76,319 SKM 3D seismic and 107 wells.

Under various campaigns by GoI, geophysical data were acquired, initially in onland basins and later, extended to offshore areas.

Under National Seismic Programme (NSP), 911 LKM 2D seismic data were acquired.

The offshore was part of 8,234 LKM East Coast EEZ 2D seismic survey programme.

The basin has been identified for drilling of one stratigraphic well under the GoI-approved plan.

University of Western Australia, Perth had carried out the stratigraphic and geomorphic analysis of deepwater deposits. The basin is under active study by University of Houston, Texas, USA.

Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Purnea	4,901	3,929 (80%)	No active acreage
Bengal Onland	37,513	28,839 (77%)	NELP: 3,942 OALP: 10,805
Shallow water	33,465	24,301 (73%)	NELP: 429 OALP: 5,756 DSF: 541
Deepwater	46,035	46,035 (100%)	NELP: 403

The basin occupies an area of 121,914 sq km. It has been appraised to the extent of 103,104 sq km. (85%). The active area under operation across regime(s) stands at 21,876 sq. km.

Current Bidding Opportunities:

Shallow water:	1 OALP block with 9,827 sq km area
Deepwater:	1 OALP block with 12,316 sq km area



COLLABORATIVE STUDIES AND OPPORTUNITIES IN OFFSHORE:

- Since May 2023 the complete geoscientific datasets of three offshore basins namely Andaman, Mahanadi and Bengal are independently studied by University of Houston (UH), Texas, USA under the scope of MoU with DGH and these data are also part of the UH-DGH Data Center set up for view and purchase by prospective bidders.
- Offshore datasets are also provided to Universities and Institutes as a part MoUs on basin research. University of Western Australia (UWA), Perth carried out stratigraphic and geomorphologic analysis on deepwater deposits of Bengal subbasin. Similarly, Indian Institute of Petroleum Energy (IIPE), Visakhapatnam, India conducted an independent study of Kerala-Konkan basin.
- Under Gol-sponsored programme, titled "EEZ Survey" to fulfill data gaps in India's EEZ, 2D seismic survey (79,540 LKM) was conducted in West coast (46,453 LKM), East coast (8,234 LKM) and Andaman (24,853 LKM).
- In another collaborative initiative and as a support of claim of India's Extended Continental Shelf (ECS) beyond EEZ by Ministry of Earth Sciences, DGH has planned 30,000 LKM of close-spaced 2D seismic survey, covering both in eastern and western offshore.
- In a recent initiative (February 2024), Gol has approved drilling of 4 stratigraphic wells in deepwater, one each in Andaman, Mahanadi, Bengal and Saurashtra. These wells will be proposed by NOCs in consultation with international experts.

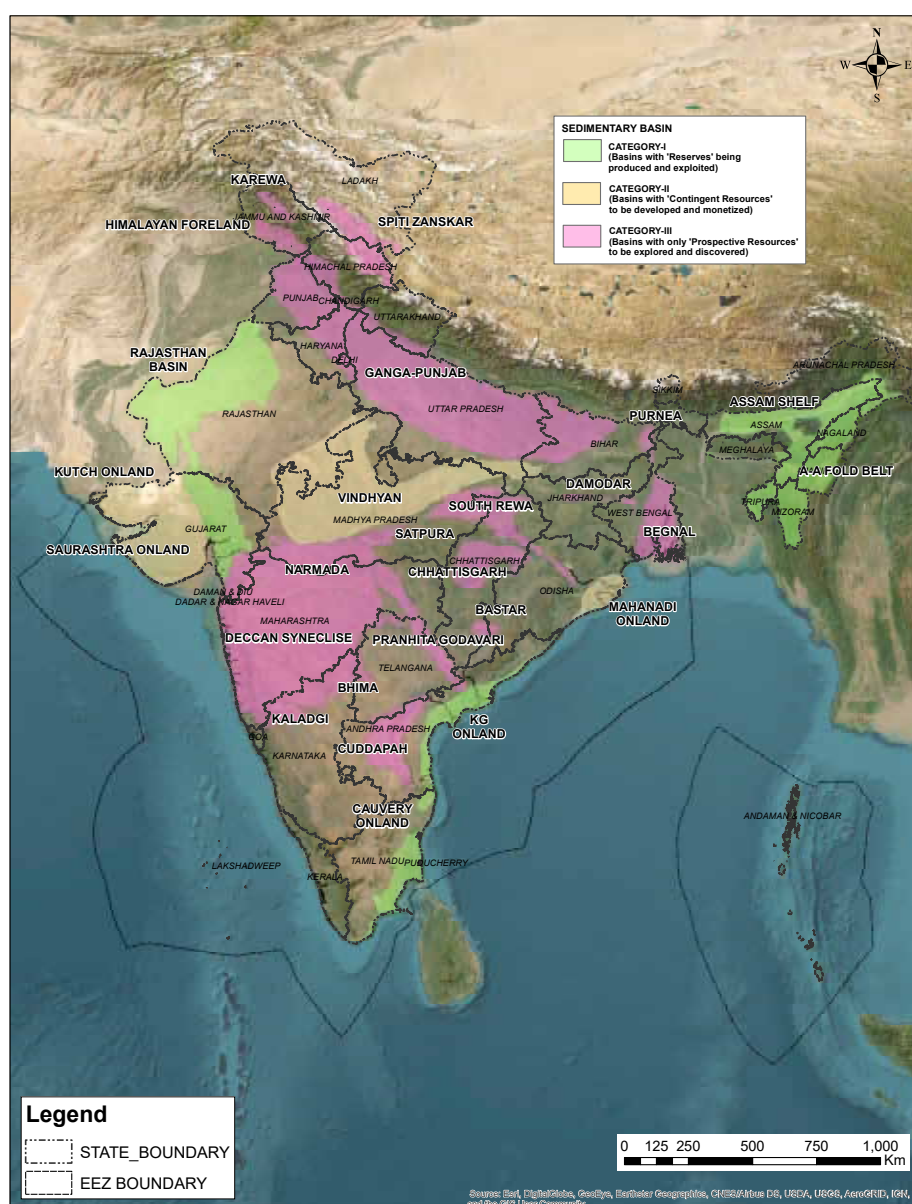


INDIA'S ONLAND BASINS

Out of 26 sedimentary basins, there are 16 basins located entirely in onland, while 7 offshore basins partially overlap onland areas. The onland basin area constitute 1.63 million sq km, which is 49% of India's total sedimentary cover. There are 4 producing basins [Rajasthan, Cambay, Assam Shelf and Assam-Arakan] located onland, while 2 offshore producing basins [KC and Cauvery] have its 14-15% area spread into onland. Geologically, onland basins have oldest stratigraphic sequences, often associated with structural complexity. Hydrocarbons are proven

and commercial in rift basins (Rajasthan-Barmer subbasin and Cambay basin), foreland basin (Assam Shelf) and fold-belt basin (Assam-Arakan). There are intra-cratonic sag basins like Vindhyan, which had recently established significant gas deposits in tight plays of Proterozoic. There are basins like Deccan Syneclise where intertrappean sediments are located within multiple flows of basalts, which are worth exploration with improvised seismic imaging.

INDIAN SEDIMENTARY BASINS: ON LAND



Source: DGH Internal



GOVERNMENT'S INITIATIVES FOR ONLAND EXPLORATION:

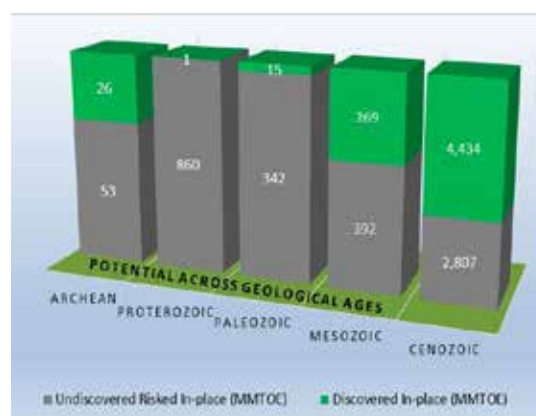
Geological complexities are often coupled with geographical challenges of inaccessible terrains of highlands and tortuous pathways. Attractive policy framework is under deliberation amongst stakeholders with GoI to encourage upstream activities like exploration into deep-seated plays (>5,000m) and production from deeper reservoirs (>4,500m). In general, the onland basins have sub-optimal subsurface geoscientific datasets. In spite of GoI's aggressive push for geophysical surveys, only 45% of onland area could be appraised (0.74

million sq km). Where seismic surveys could not be undertaken, airborne surveys were conducted to fill up seismic data gaps. All statutory clearances like Petroleum Exploration Licence (PEL), Environmental/Forest Clearance and Mining Lease are to be obtained from state administration upon contract signing or approval of GoI. In a recent initiative, composite license-cum-lease and offer of pre-cleared blocks for exploration are at the proposal stage for discussion with GoI.

ONLAND HYDROCARBON POTENTIAL:

STATE-WISE SEDIMENTARY BASIN OVERLAP AND HYDROCARBON POTENTIAL

State / UT	State area (Sq Km)	Basin area (Sq Km)	Basin to State (%)	HC Potential (MTOE)
ANDAMAN AND NICOBAR ISLANDS	8,249	128	2%	-
ANDHRA PRADESH	162,975	70,388	43%	402,027
ARUNACHAL PRADESH	83,743	7,935	9%	108,480
ASSAM	78,438	59,970	76%	907,678
BIHAR	94,163	49,411	52%	48,292
CHANDIGARH	114	1	1%	1
CHHATTISGARH	135,192	56,106	42%	47,856
DADRA AND NAGAR HAVELI AND DAMAN AND DIU	603	583	97%	55
DELHI	1,484	1,485	100%	601
GOA	3,702	87	2%	1
GUJARAT	196,024	175,509	90%	343,647
HARYANA	44,212	22,014	50%	9,660
HIMACHAL PRADESH	55,673	26,764	48%	22,686
JAMMU AND KASHMIR	55,538	19,973	36%	23,009
JHARKHAND	79,716	3,345	4%	4,154
KARNATAKA	191,791	41,094	21%	6,988
KERALA	38,863	105	0%	328
LADAKH	166,698	17,954	11%	6,172
LAKSHADWEEP	32	30	94%	-
MADHYA PRADESH	308,252	217,743	71%	555,254
MAHARASHTRA	307,713	262,245	85%	60,039
MANIPUR	22,327	19,051	85%	235,707
MEGHALAYA	22,429	2,668	12%	41,202
MIZORAM	21,081	20,973	99%	259,487
NAGALAND	16,579	15,501	93%	193,557
ODISHA	155,707	24,472	16%	32,653
PUDUCHERRY	479	397	83%	2,202
PUNJAB	50,362	38,840	77%	19,166
RAJASTHAN	342,239	159,950	47%	1,344,637
TAMIL NADU	130,058	34,741	27%	167,338
TELANGANA	112,077	25,639	23%	42,607
TRIPURA	10,491	10,313	98%	127,597
UTTAR PRADESH	240,928	201,391	84%	115,160
UTTARAKHAND	53,483	10,930	20%	9,528
WEST BENGAL	88,752	38,328	43%	205,749



Source: DGH Internal

NOTE:

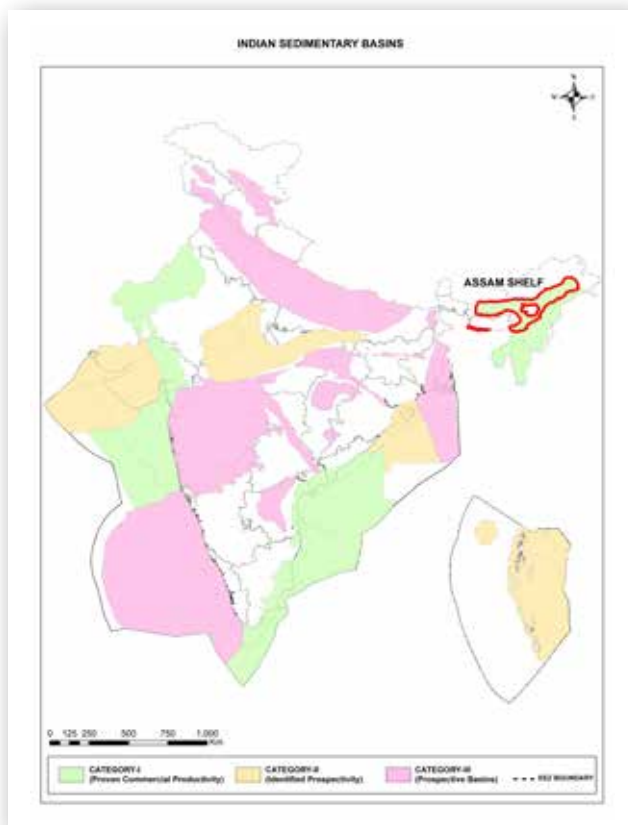
- State/UT names and areas are as per July 2013 information web-sourced from India's Ministry of Statistics and Programme Implementation. This is subject to appropriate authentication by NDR-DGH, for relevant use.
https://web.archive.org/web/20131203163229/http://mospi.nic.in/mospi_new/upload/SYB2013/ch2.html
- The total state area adds up to 3,287,263 sq km, which works out to India's geographical area.
- The total basin area adds up to 1,636,064 sq km, which works out to India's onland basin area.
- The HC (Hydrocarbon) Potential is expressed in MTOE (Thousand Ton Oil Equivalent) and it represents Undiscovered Potential that is geologically risk-weighted. This has been worked out based on basin-level Aerial Yield (HC potential/area), applied to overlapping basin area in the respective State/ UT. This is indicative and may not tally with play-level estimates that are more geological and limited to basins only.
- Coastal States/ UT including Island Administration may have adjacent offshore regions with HC potential.
- Sikkim is the only state, where no petroliferous basin is hitherto speculated.



1. ASSAM SHELF BASIN

Assam Shelf is a Category I basin, implying that the basin has significant commercial discovered inplace, potential to be produced at an optimum level.

The geographical area of the basin partially overlaps with the state(s) of Arunachal Pradesh, Assam, Meghalaya and Nagaland.



Source: DGH Internal



Source: DGH Internal

Metamorphic complex. Gondwana sediments are exposed in the western extremity of Garo Hills. The basin unconformably extends up to the northern bank of Brahmaputra river.

Mature source rocks lie below the Naga thrust belt, which is pivotal to future exploration focus. Shallow play near Naga-Schuppen belt remains focus area of exploration.

The Assam Shelf Basin is situated in the north-east region of Indian peninsula.

Commercial hydrocarbon occurrences, besides Basement, spread over different stratigraphic intervals ranging from the oldest sediments of Paleocene (Tura) to the youngest sediments of Pliocene (Girujan). Several oil and gas fields have been discovered within structural, stratigraphic and strati-structural entrapment conditions.

The basin hosts thick pile of Tertiary sediments, ranging from Paleocene to Recent which overlies Basement consisting of Granitic and

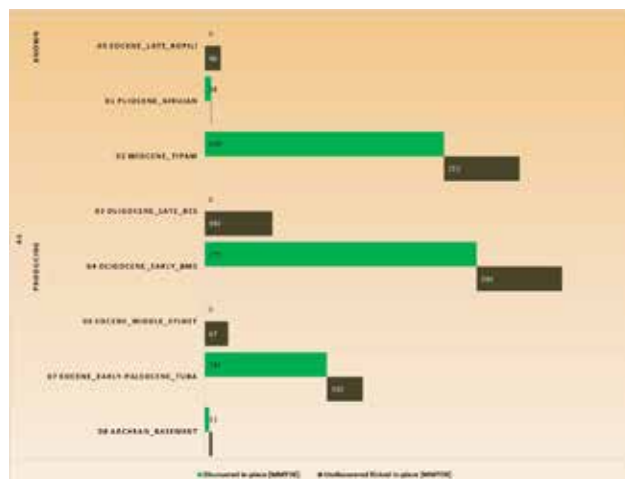


Hydrocarbon prospectivity and Basin maturity:

In the basin, 8 plays are identified within Basement and Tertiary. Petroleum system was modelled in 3D basis adequate datasets.

Assam Shelf basin has a total hydrocarbon in-place of 2,700 MMTOE. This includes discovered in-place of 1,826 MMTOE and undiscovered risked in-place of 874 MMTOE.

The discovered in-place is under commercial production. The basin has 32.4% of total in-place, potential to be explored and discovered.



Source: DGH Internal

Discoveries and Development:

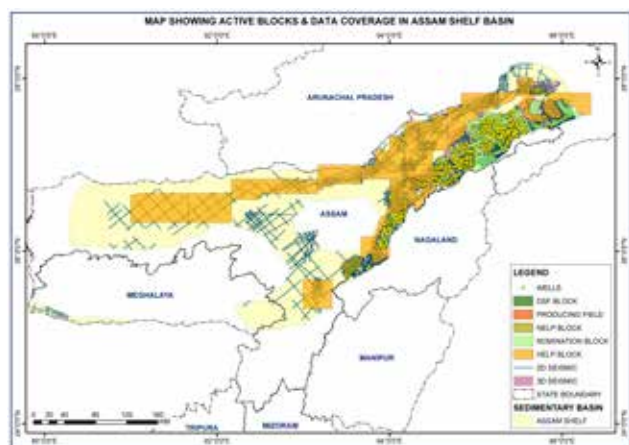
2 field development plans were reviewed during the year under Pre-NELP(1) and DSF(1) regime in Onland.

Overview of producing fields:

Commercial production, post India's independence commenced in 1965. Major producing fields with cumulative production in parenthesis are namely Rudrasagar (11 MMT, 3 BCM), Borholla (3 MMT), Greater Naharkatiya (56 MMT, 33 BCM), Greater Moran (19 MMT, 6.5 BCM) Greater Jorajan (16 MMT, 19 BCM) Greater

Hapjan (25 MMT, 8 BCM), Greater Chandmari (70 MMT, 8.5 BCM) Geleki & North Geleki (19 MMT, 6.7 BCM). The sub-basin has 47 fields with 1,404 wells. The maximum flow rates achieved by any field on record in 2023-24 are, Oil 20,400 BOPD and Gas 4 MMSCMD.

Basin datasets, studies and opportunities:



Source: DGH Internal

As of 31.03.2024, NDR has archived data of 62,493 LKM 2D seismic, 40,830 SKM 3D seismic and 3,097 wells.

Under various campaigns by GoI, geophysical data were acquired in onland area. Under National Seismic Programme (NSP), 3,160 LKM 2D seismic data were acquired.

Wadia Institute of Himalayan Geology, Dehradun, India carried out tectonic anomaly study using AI/ML technique in Amguri field and adjoining areas.



Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	56,000	45,316 (81%)	Nomination: 5,883; Fields: 56; NELP: 567; OALP: 19,015; DSF: 202

The basin occupies an area of 56,000 sq km. It has been appraised to the extent of 45,316 sq km. (81%). The active area under operation across regime(s) stands at 25,723 sq. km.

Current Bidding Opportunities:

Onland:

2 OALP blocks with 2,952 sq km area

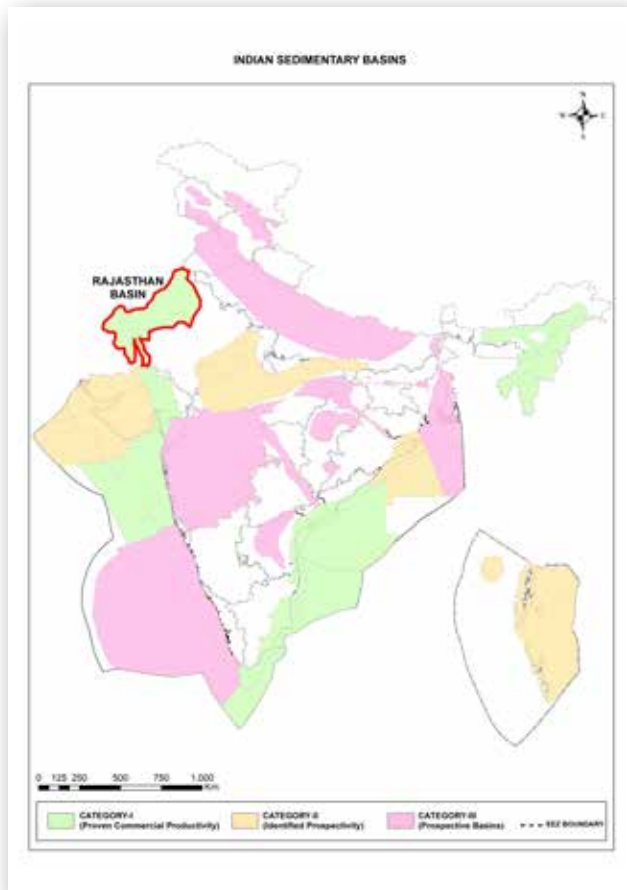
2. RAJASTHAN BASIN

Rajasthan is a Category I basin, implying that the basin has significant commercial discovered inplace, potential to be produced at an optimum level.

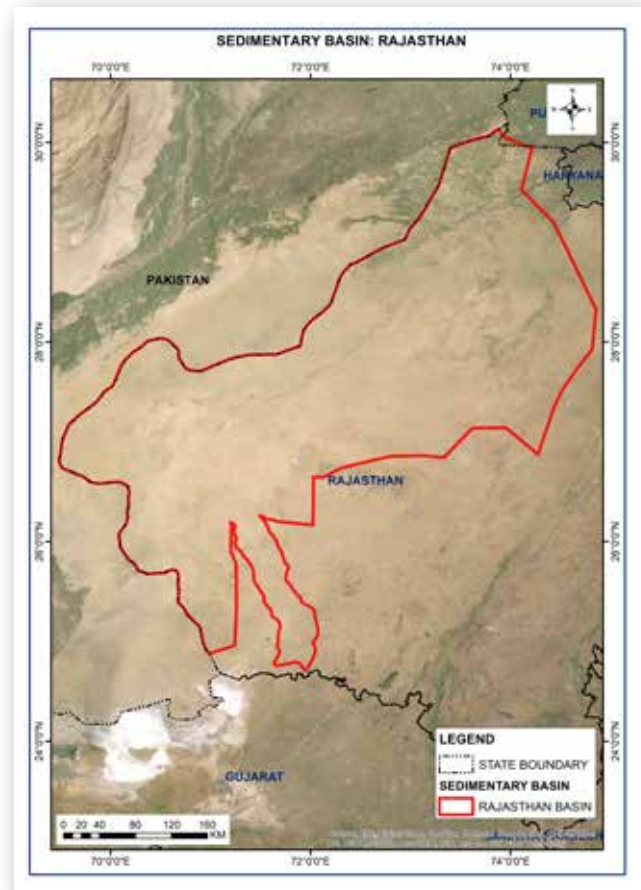
Barmer sub-basin partially overlaps with the state of Rajasthan.

Jaisalmer sub-basin partially overlaps with the state of Rajasthan.

Bikaner-Nagaur sub-basin partially overlaps with the state(s) of Punjab and Rajasthan.



Source: DGH Internal



Source: DGH Internal



Barmer sub-basin is situated in the western region of Indian peninsula and the most prominent among the three sub-basins of Rajasthan basin. The sub-basin accounts for one-fourth of oil production of the country. Commercial hydrocarbon occurrences, besides Deccan Trap and Basement, are found in different stratigraphic intervals ranging from the oldest sediments of Cretaceous (Ghaggar-Hakra) to the youngest sediments of Paleocene and Eocene (Barmer Hill, Fatehgarh, Thumbli). Several oil and gas fields have been discovered within structural, stratigraphic and strati-structural entrapment conditions, out of which majority of the discoveries are encountered in Tertiary sediments. Multiple source rocks are evident with instances of same play acting

as source and reservoirs. Fatehgarh and Barmer Hill of Paleocene are major producing sequences of the subbasin.

The Jaisalmer sub-basin is mainly a Mesozoic rift basin set up during Permo-Triassic period.

The Bikaner-Nagaur is a shallow Proterozoic sub-basin with a Pre-Cambrian basement comprised of the Malani igneous suite and Delhi metamorphites. The sub-basin is a part of Punjab platform of Indus basin, having a general dip towards west and sedimentary units thickening towards northwest.

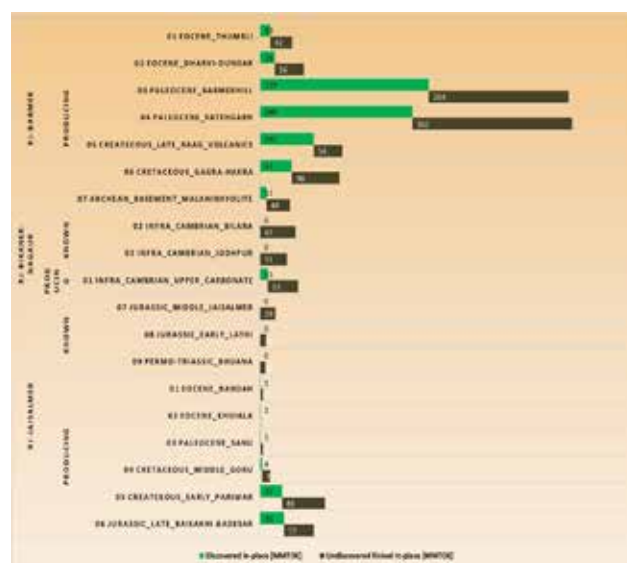
Permo-Triassic & Jurassic plays in Jaisalmer and Cretaceous (Ghaggar-Hakra) plays in Barmer are potential exploration targets.

Hydrocarbon prospectivity and Basin maturity:

7 plays are identified within Basement, Cretaceous, Volcanics, Paleocene-Eocene in Barmer sub-basin. 9 plays are known within Jurassic- Cretaceous, Paleocene-Eocene in Jaisalmer sub-basin. 3 plays are located within Pre-Cambrian in Bikaner- Nagaur sub-basin. Petroleum system was modelled in 3D basis adequate datasets.

Barmer sub-basin has a total hydrocarbon in-place of 1,680 MMTOE. This includes discovered in-place of 828 MMTOE and undiscovered risked in-place of 852 MMTOE. The discovered in-place is under commercial production. The basin has 50.7% of total inplace, potential to be explored and discovered.

Jaisalmer sub-basin has a total hydrocarbon in-place of 307 MMTOE. This includes discovered in-place of 94 MMTOE and undiscovered risked in-place of 213 MMTOE. The discovered in-place is under commercial production. The basin has 69.4% of total inplace, potential to be explored and discovered.



Source: DGH Internal

Bikaner-Nagaur sub-basin has a total hydrocarbon in-place of 190 MMTOE. This includes discovered in-place of 15 MMTOE and undiscovered risked in-place of 175 MMTOE. The discovered in-place is under commercial production. The basin has 92.1% of total inplace, potential to be explored and discovered.

Discoveries and Development:

6 field development plans were reviewed during the year under Pre-NELP(5) and DSF(1) regime in Onland.



Overview of producing fields:

Commercial production commenced in 2009. Major producing fields with cumulative production in parenthesis are namely RJ-ON-90/1 (99 MMT, 14 BCM), RJ-ON/6 (3 BCM),

Baghewala (Heavy Oil). The basin has 7 fields with 768 wells. The maximum flow rates achieved by any field on record in 2023-24 are, Oil 80,000 BOPD and Gas 5 MMSCMD.

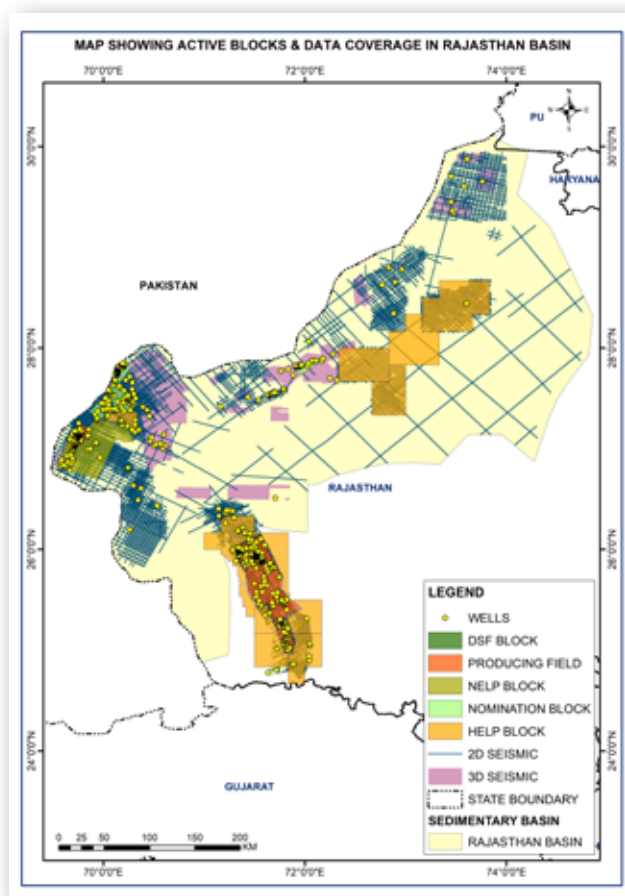
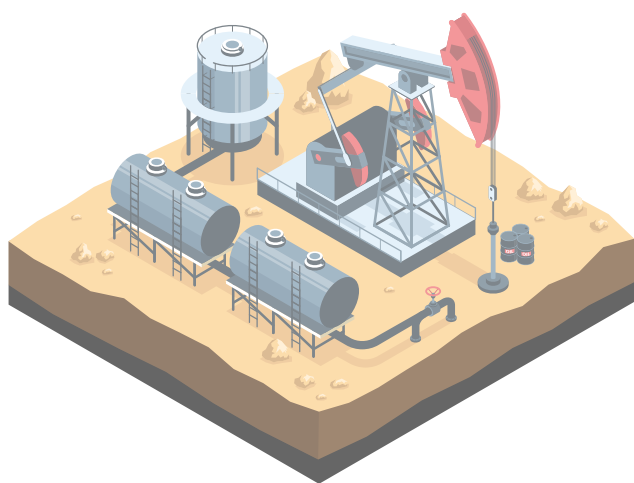
Basin datasets, studies and opportunities:

As of 31.03.2024, NDR has archived data of 84,755 LKM 2D seismic, 41,881 SKM 3D seismic and 1,524 wells.

Under various campaigns by GoI, geophysical data were acquired in onland area.

Under National Seismic Programme (NSP), 2,752 LKM 2D seismic data were acquired.

In another initiative, titled Mission Anveshan 4,300 LKM 2D seismic are planned as an in-fill data acquisition campaign of NSP.



Source: DGH Internal

Basin appraisal and active acreage:

Location	Basin area(skm)	Appraised(skm)	Active area (skm) across regime
Onland	126,000	75,568 (60%)	Nomination: 1,286; Fields: 3,294; NELP: 2,538; OALP: 12,402; DSF: 167

The basin occupies an area of 126,000 sq km. It has been appraised to the extent of 75,568 sq km. (60%). The active area under operation across regime(s) stands at 19,687 sq. km.

Current Bidding Opportunities:

Onland:

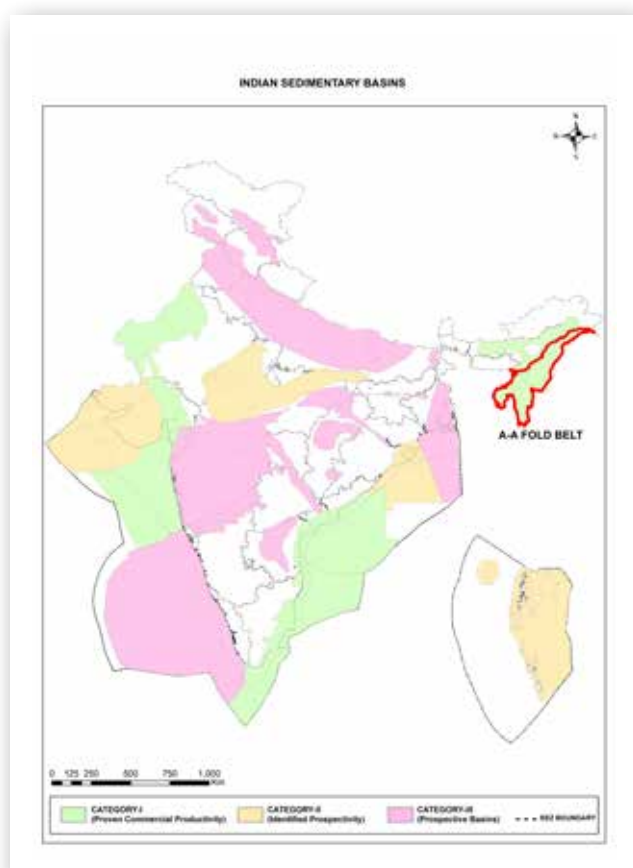
1 OALP block with 5,953 sq km area



3. ASSAM-ARAKAN FOLD BELT (AAFB) BASIN

Assam-Arakan Fold Belt (AAFB) is a Category I basin, implying that the basin has significant commercial discovered inplace, potential to be produced at an optimum level.

The geographical area of the basin partially overlaps with the state(s) of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura.



Source: DGH Internal

The basin is characterized primarily by siliciclastic deposits of fluvial to shelf margin setup, situated in the northeast region of Indian peninsula.

Commercial hydrocarbon occurrences are mainly encountered within Miocene and Pliocene formation except some small discoveries in Oligocene and Eocene sequences. Several gas pools have been discovered within the structural closure while hydrocarbon accumulations often indicate charging from deeper sequences.

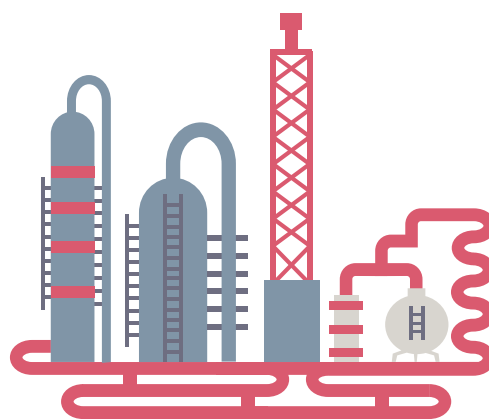


Source: DGH Internal

The basin hosts a thick pile of tertiary sediments, ranging from Paleocene to Recent, which overlies the archaic basement consisting of granitic and metamorphic rocks.

Mio-Pliocene petroleum system is discovered and producing. Deepest Oligocene play (Renji) is yet to be thoroughly explored. All proven system has significant risked resources.

The fact that structural traps primarily had formed since Miocene, sequential restoration and migration of thrusts are the focus area.



Hydrocarbon prospectivity and Basin maturity:

In the basin, 7 plays are identified within Eocene-to- Pliocene. Petroleum system was modelled in 3D where datasets were adequate and Aerial Yield method was used where data were limited.

Assam-Arakan Fold Belt (Aafb) basin has a total hydrocarbon in-place of 1,176 MMTOE. This includes discovered in-place of 176 MMTOE and undiscovered risked in-place of 1,000 MMTOE.

The discovered in-place is under commercial production. The basin has 85% of total inplace, potential to be explored and discovered.



Source: DGH Internal

Overview of producing fields:

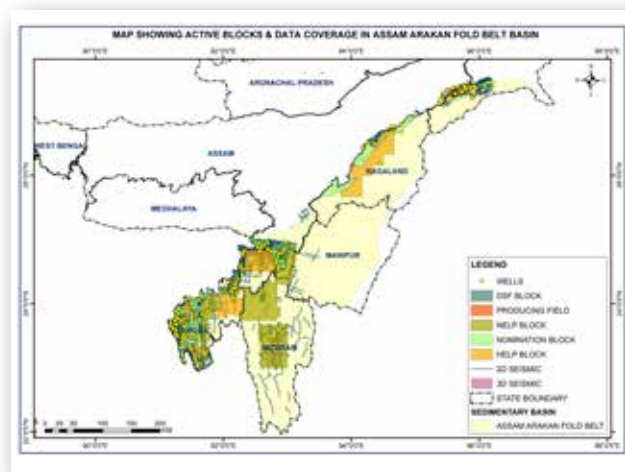
Commercial production commenced in 1985. Major producing fields with cumulative production in parenthesis are namely Agartala Dome (9 BCM), Konaban(7 BCM), Baramura(2.4

BCM), Sundulbari(1 BCM). The basin has 13 fields with 171 wells. The maximum flow rate achieved by any field on record in 2023-24 is Gas 1 MMSCMD.

Basin datasets, studies and opportunities:

As of 31.03.2024, NDR has archived data of 32,025 LKM 2D seismic, 20,523 SKM 3D seismic and 456 wells.

Under various campaigns by GoI, geophysical data were acquired in onland area. Under National Seismic Programme (NSP), 2,085 LKM 2D seismic data were acquired. Under Air-borne Gravity- Gradiometry(AGG) survey, 26,997 FLKM data were acquired in inaccessible and operationally challenging areas where seismic survey under NSP couldnot be conducted.



Source: DGH Internal

Basin appraisal and active acreage:

Location	Basin area(skm)	Appraised(skm)	Active area (skm) across regime
Onland	80,825	30,176 (37%)	Nomination: 5,569 Fields: 87 NELP: 10,321 OALP: 6,983 DSF: 640

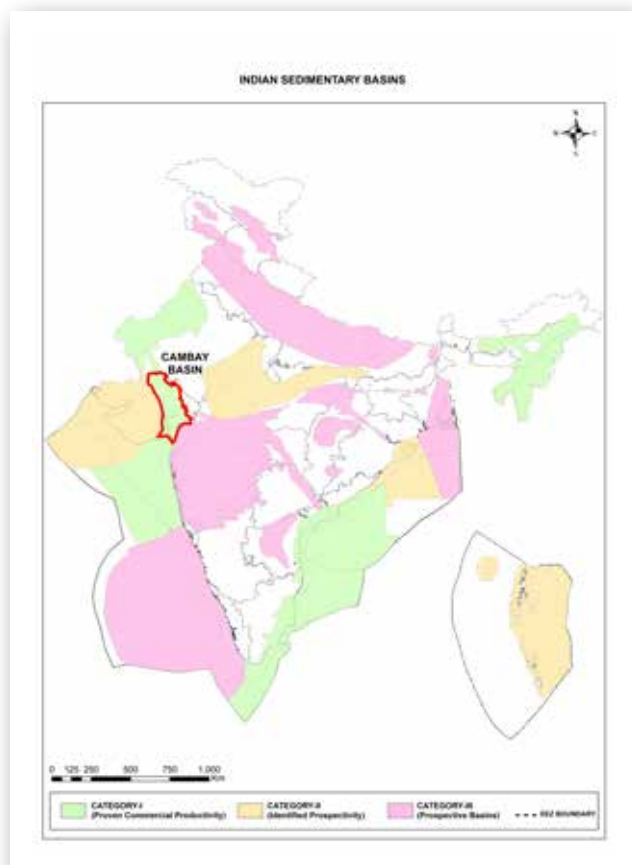
The basin occupies an area of 80,825 sq km. It has been appraised to the extent of 30,176 sq km. (37%). The active area under operation across regime(s) stands at 23,600 sq. km.



4. CAMBAY BASIN

Cambay is a Category I basin, implying that the basin has significant commercial discovered inplace, potential to be produced at an optimum level.

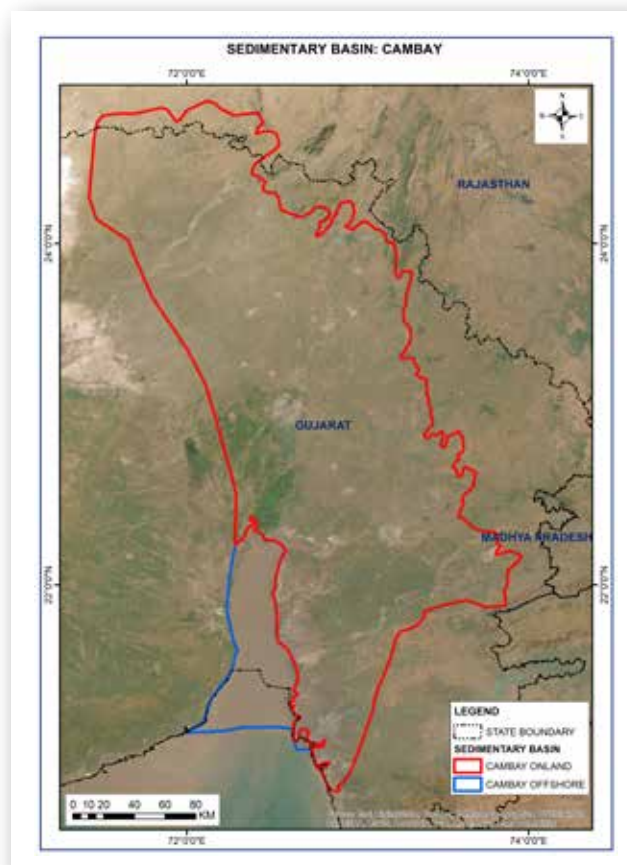
Onland sub-basin partially overlaps with the state(s) of Gujarat and Rajasthan.



Source: DGH Internal

The basin is characterized primarily by siliciclastic rift-fill sediments, situated in the western region of Indian peninsula. The basin is endowed with most matured petroleum provinces of India with major producing fields and 88% of total hydrocarbons already discovered.

The Cambay basin, though enough exploited, is still under active exploration for opening deeper plays. Commercial hydrocarbon occurrences spread over different stratigraphic intervals ranging from the oldest sediments, including Deccan Trap volcanics of Cretaceous-Paleocene to the youngest sediments of Miocene. Several oil and gas fields have been discovered with structural, stratigraphic and strati-structural



Source: DGH Internal

entrapment conditions, out of which two-third of the discoveries has been made in Middle Eocene.

The basin hosts a thick pile of Tertiary sediments, ranging from Paleocene to Recent which is overlying the Deccan Trap.

Cambay shale of Paleocene is the major source rock charging Middle Eocene reservoirs of Kalol (north and central) and Hazad (southern) deltaic reservoirs with Tarapur (Oligocene) acting as the regional cap rock. During later exploration, Miocene reservoirs (Babaguru) are proved to be potential reservoirs of oil and gas in southern onland part of the basin and the offshore area that extends into the Gulf of Cambay.



Paleogene plays (Akholjuni, Gandhar) and Mesozoic remain the key focus area of the basin.

Several source rock units exist ranging from Lower Paleocene (Olpad, TOC: 1.38-5.69%, OM is Type III/II+III), Upper Paleocene (Older Cambay Shales, TOC-2.02-7.35%, OM Type III), Early Eocene (Younger Cambay shale, TOC-1.46-

6.59%, OM Type II+III), Middle Eocene (Mandhali, Kanwa Shales, TOC-2.0-6.12%, OM Type III) and Late Eocene (Ardol/Telwa Shale, TOC-2.37-7.0%, OM Type III). The principle source units are the deltaic, lagoonal and shallow marine shales of the Paleocene to Middle Eocene age, with lesser inputs from lacustrine shales of the Paleocene Olpad Formation.

Hydrocarbon prospectivity and Basin maturity:

In the basin, 7 plays exist within Basement, Paleocene, Eocene and Miocene. Petroleum system was modelled in 3D basis adequate datasets.

Onland sub-basin has a total hydrocarbon in-place of 2,054 MMTOE. This includes discovered in-place of 1,801 MMTOE and undiscovered risked in-place of 253 MMTOE.

The discovered in-place is under commercial production. The basin has 12.3% of total in-place, potential to be explored and discovered.



Source: DGH Internal

Discoveries and Development:

1 discovery was notified during the year under OALP regime in Onland. 11 field development plans were reviewed during the year under Pre-NELP(3), NELP(4), OALP(1) and DSF(3) regime in Onland.

2 field development plans were reviewed during the year under DSF regime in Shallow water.

Overview of producing fields:

Commercial production in Onland sub-basin commenced in 1958. Major producing fields with cumulative production in parenthesis are namely Gandhar (42 MMT, 40 BCM), North Kadi (27 MMT, 2 BCM), Kalol (18 MMT, 12 BCM), Santhal (17 MMT). The sub-basin has 42 fields with 560 wells. The maximum flow rates achieved by any field on record in 2023-24 are, Oil 11,600 BOPD and Gas 1 MMSCMD.

Commercial production in Shallow water sub-basin commenced in 2002. Major producing fields with cumulative production in parenthesis are namely CB-OS/2 (7 MMT, 8 BCM). The sub-basin has 2 fields with 29 wells. The maximum flow rates achieved by any field on record in 2023-24 are, Oil 4,300 BOPD.

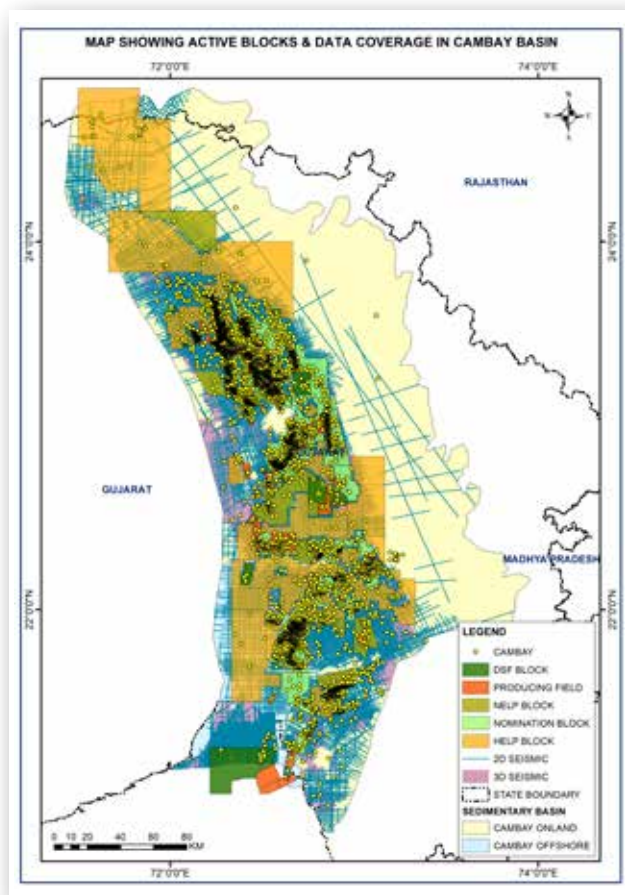


Basin datasets, studies and opportunities:

As of 31.03.2024, NDR has archived data of 153,134 LKM 2D seismic, 49,689 SKM 3D seismic and 9,249 wells.

Under various campaigns by GoI, geophysical data were acquired in onland area.

Under National Seismic Programme (NSP), 1,469 LKM 2D seismic data were acquired.



Source: DGH Internal

Basin appraisal and active acreage:

Location	Basin area(skm)	Appraised(skm)	Active area (skm) across regime
Onland	48,882	44,374 (91%)	Nomination: 6,008 Fields: 864 NELP: 2,290 OALP: 9,803 DSF: 391
Shallow water	4,618	4,618 (100%)	Nomination: 69 Fields: 16 NELP: 4 OALP: 1,798 DSF: 424

The basin occupies an area of 53,500 sq km. It has been appraised to the extent of 48,992 sq km. (92%). The active area under operation across regime(s) stands at 21,667 sq. km.

Current Bidding Opportunities:

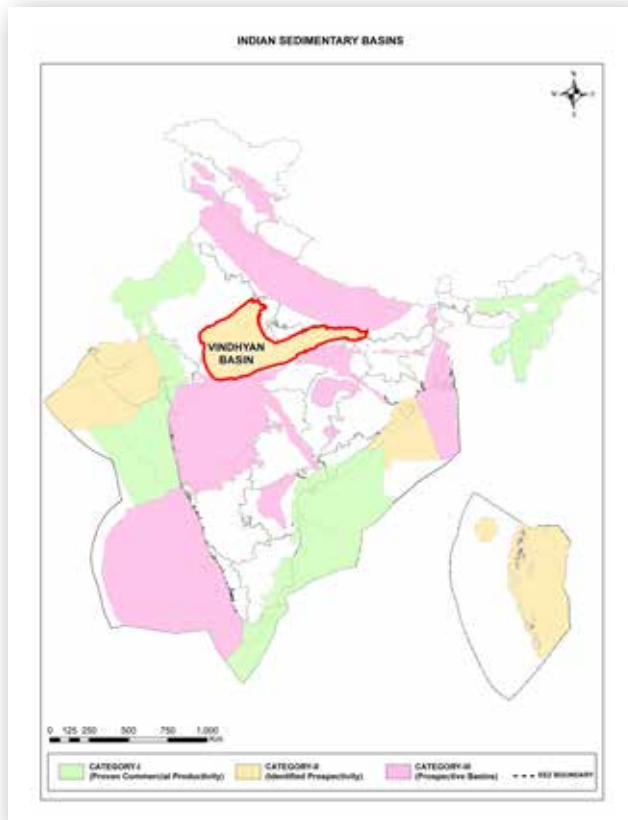
Onland:	5 OALP blocks with 2,339 sq km area
Shallow water	2 OALP blocks with 2,350 sq km area



5. VINDHYAN BASIN

Vindhyan is a Category II basin, implying that the basin has sub-commercial discovered inplace, potential to be commercially produced.

The geographical area of the basin partially overlaps with the state(s) of Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh.



Source: DGH Internal

Vindhyan Basin occupies the numero uno position amongst all the Proterozoic petroliferous basins of India due to its large areal extent and significant discoveries in recent years.

The exploratory efforts for hydrocarbon in the basin commenced in 1970's, it is only after the initial successes met at wells Jabera-1, Nohta-2 and Damoh-4, its hydrocarbon prospectivity has been perceived gradually.

In the basin, three major stratigraphic horizons, viz. Rohtas, Mohana and Jardepahar were identified.



Source: DGH Internal

Reservoir layers are tight with low porosity and permeability.

The Arangi, Kajrahat, Charkharia Shale, and Rohtas Shale/Limestones are the principal source rock with TOC 0.5-2.85 %. Large area of the basin is overlain by Deccan Traps. Sub-basalt imaging could add to improved insights into sub-trappean sequences. Inherent uncertainties associated with age of Vindhyan strata may be corroborated with the biostratigraphic data.



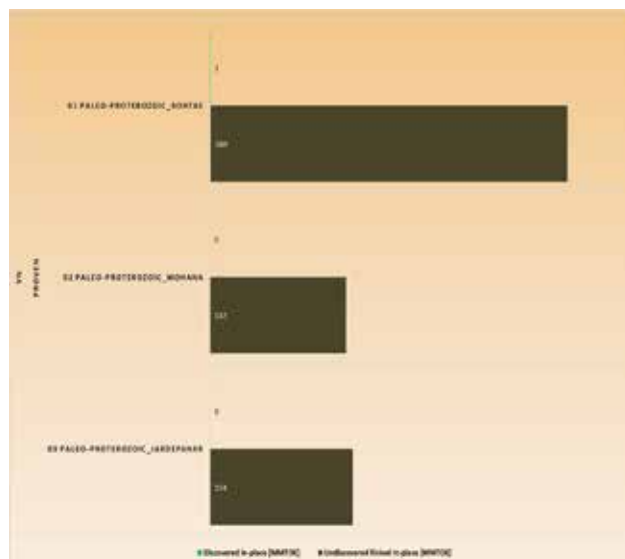
Hydrocarbon prospectivity and Basin maturity:

In the basin, 3 plays are known within Pre-Cambrian-to- Paleozoic (Jardepahar-Mohana-Rohtas sequences).

Aerial Yield method was used for each play following intra-basin calibration.

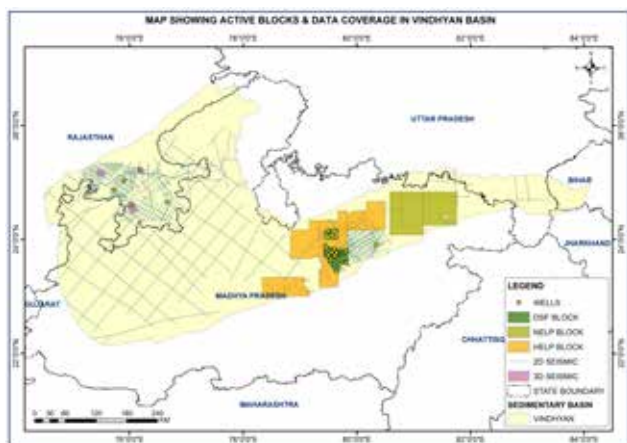
Vindhyan basin has a total hydrocarbon in-place of 685 MMTOE. This includes discovered in-place of 1 MMTOE and undiscovered risked in-place of 684 MMTOE.

The discovered in-place is subject to commercial development. The basin has 99.9% of total inplace, potential to be explored and discovered.



Source: DGH Internal

Basin datasets, studies and opportunities:



Source: DGH Internal

As of 31.03.2024, NDR has archived data of 25,243 LKM 2D seismic, 1,480 SKM 3D seismic and 27 wells.

Under various campaigns by GoI, geophysical data were acquired in onland area. Under National Seismic Programme (NSP), 5,373 LKM 2D seismic data were acquired.

Rajiv Gandhi Institute of Petroleum Technology (RGPT), Amethi, India has carried out geoscientific data analysis as a part of basin-scale research study.

Basin appraisal and active acreage:

Location	Basin area(skm)	Appraised(skm)	Active area (skm) across regime
Onland	202,888	54,925 (27%)	NELP: 9,076 OALP: 13,056 DSF: 1,472

The basin occupies an area of 202,888 sq km. It has been appraised to the extent of 54,925 sq km. (27%). The active area under operation across regime(s) stands at 23,604 sq. km.

Current Bidding Opportunities:

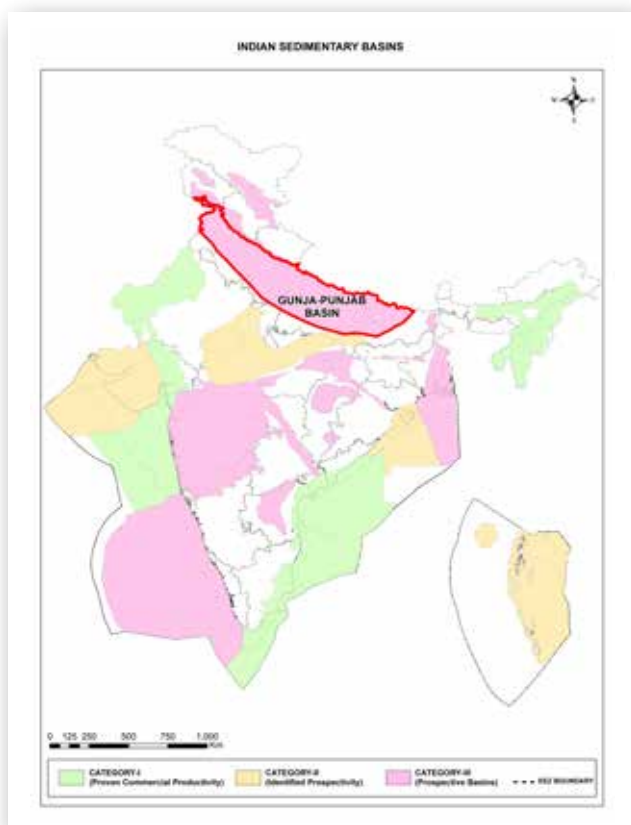
Onland:

1 OALP block with 4,275 sq km area



6. GANGA-PUNJAB BASIN

Ganga-Punjab is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery.



Source: DGH Internal

The Indo-Gangetic plain, which is the extensive alluvial plain of Ganga, Indus and Brahmaputra rivers and their tributaries, separates the Himalayan range from peninsular India. Ganga valley and Punjab plain are the integral part of Indo-Gangetic plain, representing the river Ganga and Indus catchment area respectively.

Ganga-Punjab basin is covered by thick alluvium, which conceals the pre-collisional (Indo-Eurasian plates) Proterozoic and post-collisional Tertiary records. Post-collision flexuring of the Indian lithosphere and thrust-fold loading produced the Himalayan peripheral foreland in Early Miocene. The basin expanded during Middle Miocene and attained its present configuration in Late Quaternary.

The geographical area of the basin partially overlaps with the state(s) of Bihar, Chandigarh, Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh, Punjab, Uttar Pradesh and Uttarakhand.



Source: DGH Internal

The exploration in the Ganga-Punjab basin started in late 1950. M/s ONGC started exploration in the year 1978-79 in the Gandak depression of the Ganga sub-basin. M/s Cairn and M/s OIL carried out seismic surveys in the Kashipur block of Sarda depression.

The basin has close analogy with Vindhyan basin and Duarmara field of Assam Shelf. In Ganga sub-basin two speculative plays have been identified i.e. Neo-Proterozoic unconventional play and Middle Miocene conventional play. Whereas in Punjab sub-basin only one hypothetical play i.e. Middle Miocene Play is envisaged as only Tertiary sediments, resting directly over metamorphic basements. Ganga sub-basin Neo-Proterozoic play is unconventional tight gas play like Vindhyan play. Middle Miocene play (Lower Siwalik) has been considered as a conventional play.

Neo-Proterozoic shale are found to be organic rich with TOC 0.41-2.96%, while shales of Siwaliks have reached early window of hydrocarbon generation but are expected to be within the matured oil window in the sub-thrust area. The



migration is envisaged to be through faults and fractures with sandstone reservoirs of Proterozoic akin to Vindhyan Basin while the Miocene fluvial sandstones are envisaged to be

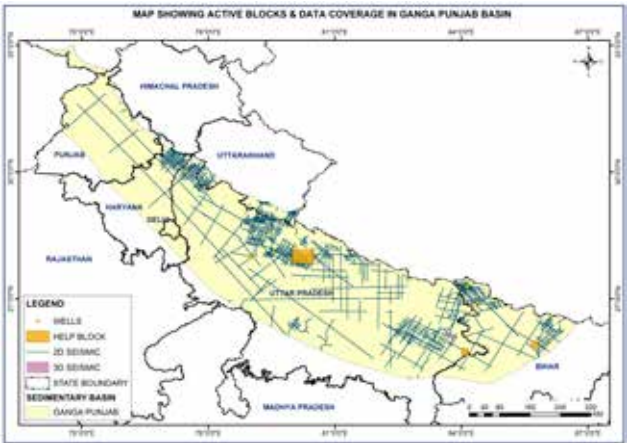
good quality reservoir. Inherent uncertainties regarding dating of Ganga and Punjab Plain Subsurface stratigraphy calls for integration of the biostratigraphic data (mainly acritarchs).

Hydrocarbon prospectivity and Basin maturity:

In the basin, 2 plays are known within Pre-Cambrian and Mid Miocene. Aerial Yield method was used on analogy of Vindhyan basin (Pre-Cambrian sequences) and Duarmara gas field of Assam state (Tertiary sequences).

Ganga-Punjab basin has a total hydrocarbon in-place of 126 MMTOE and this is entirely undiscovered risked in-place.

Basin datasets, studies and opportunities:



Source: DGH Internal

As of 31.03.2024, NDR has archived data of 35,761 LKM 2D seismic, 1,363 SKM 3D seismic and 19 wells.

Under various campaigns by GoI, geophysical data were acquired in onland area. Under National Seismic Programme (NSP), 3,858 LKM 2D seismic data were acquired. In another initiative, titled Mission Anveshan 5,100 LKM 2D seismic are planned as an in-fill data acquisition campaign of NSP.

Rajiv Gandhi Institute of Petroleum Technology (RGPT), Amethi, India has carried out geo-scientific data analysis as a part of basin-scale research study.

Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	304,000	104,465 (34%)	OALP: 2,428

The basin occupies an area of 304,000 sq km. It has been appraised to the extent of 104,465 sq km. (34%). The active area under operation across regime(s) stands at 2,428 sq. km.

Current Bidding Opportunities:

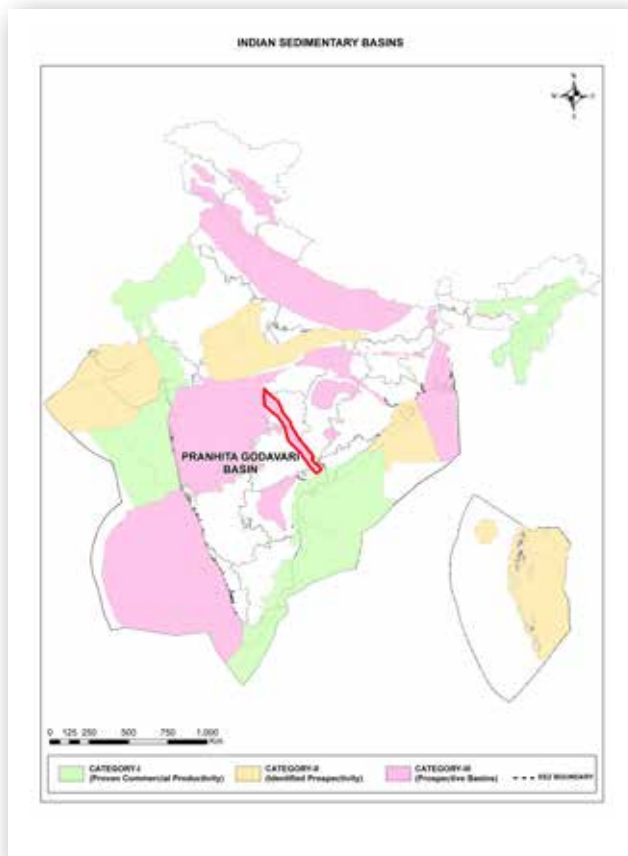
Onland:	1 OALP block with 5,241 sq km area
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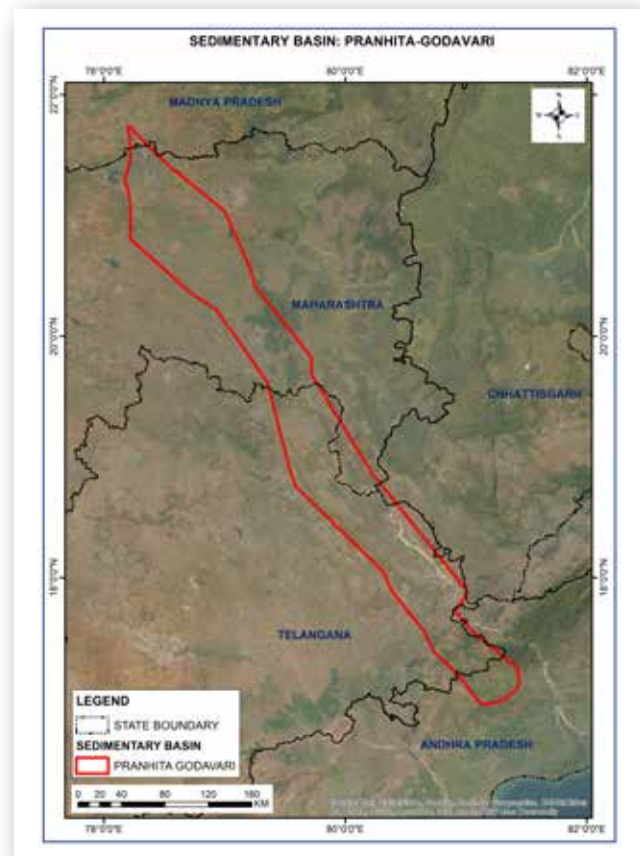
7. PRANHITA-GODAVARI (PG) BASIN

Pranhita-Godavari (PG) is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery.

The geographical area of the basin partially overlaps with the state(s) of Andhra Pradesh, Chhattisgarh, Madhya Pradesh, Maharashtra and Telangana.



Source: DGH Internal



Source: DGH Internal

The basin is a NW-SE trending intracratonic rift, located over Peninsular India and bounded by metamorphic rocks of Bastar to its northeast and Dharwar cratons to its southwest.

Potential plays are envisaged in Talchir, Barakar, Lower, Middle and Upper Kamthi Formations.

Geological data indicates presence of about 4 to 5 Km of sediments. The oldest sediments known from surface exposures are the Lower Proterozoic overlain by Gondwana sediments.

The basin has the close analogy with Mandapeta area of the KG Basin.

Lower Gondwana Barakar and the Barren sediments are rich in organic carbon content with source rock characteristics, with TOC 1.98-30.4%. Development of reservoir facies is expected both in Barakar and Kamthi Formations. Structural entrapment is envisaged in the Sironcha block.

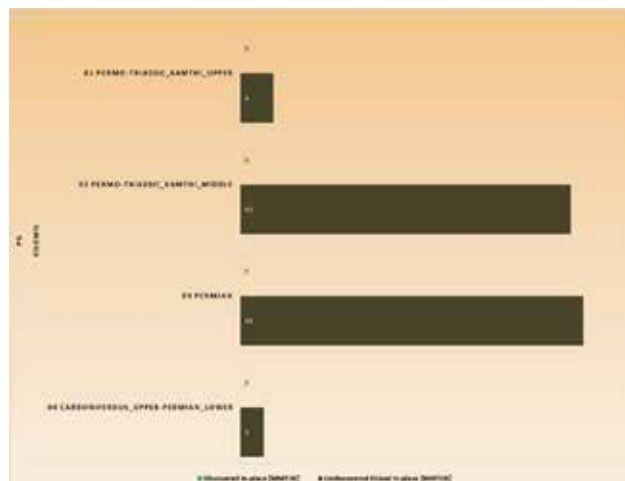


Hydrocarbon prospectivity and Basin maturity:

In the basin, 4 plays exist within Lower Permian-to- Lower Triassic. Aerial Yield method was used on analogy of KG Basin.

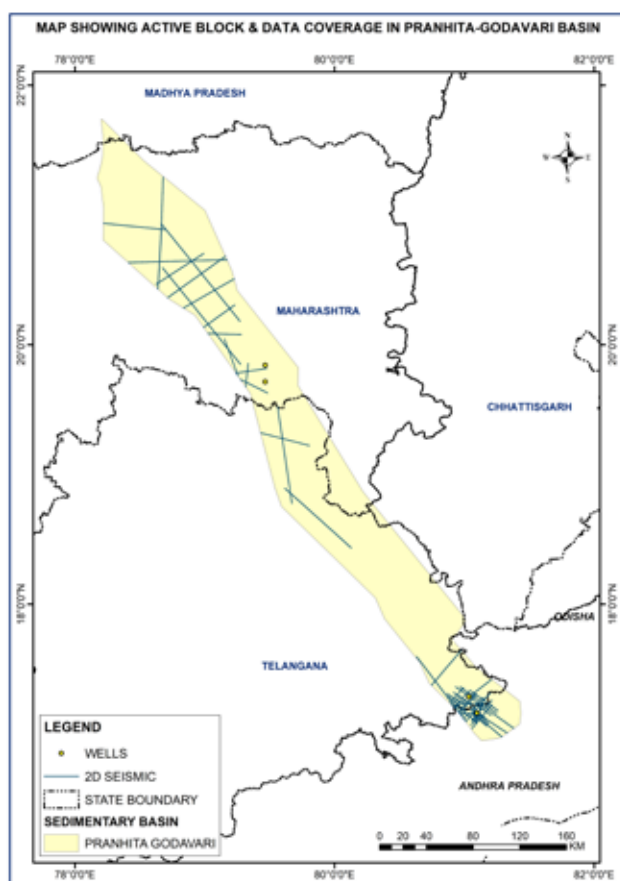
The study incorporated geological maps, GM data and geochemical data from source rock samples.

Pranhita-Godavari (PG) basin has a total hydrocarbon in-place of 94 MMTOE and this is entirely undiscovered risked in-place.



Source: DGH Internal

Basin datasets, studies and opportunities:



Source: DGH Internal

As of 31.03.2024, NDR has archived data of 3,745 LKM 2D seismic and 4 wells.

Under various campaigns by GoI, geophysical data were acquired in onland area.

Under National Seismic Programme (NSP), 735 LKM 2D seismic data were acquired.



Basin appraisal and active acreage:

Location	Basin area(skm)	Appraised(skm)	Active area (skm) across regime
Onland	30,000	9,489 (32%)	No active acreage

The basin occupies an area of 30,000 sq km. It has been appraised to the extent of 9,489 sq km. (32%)



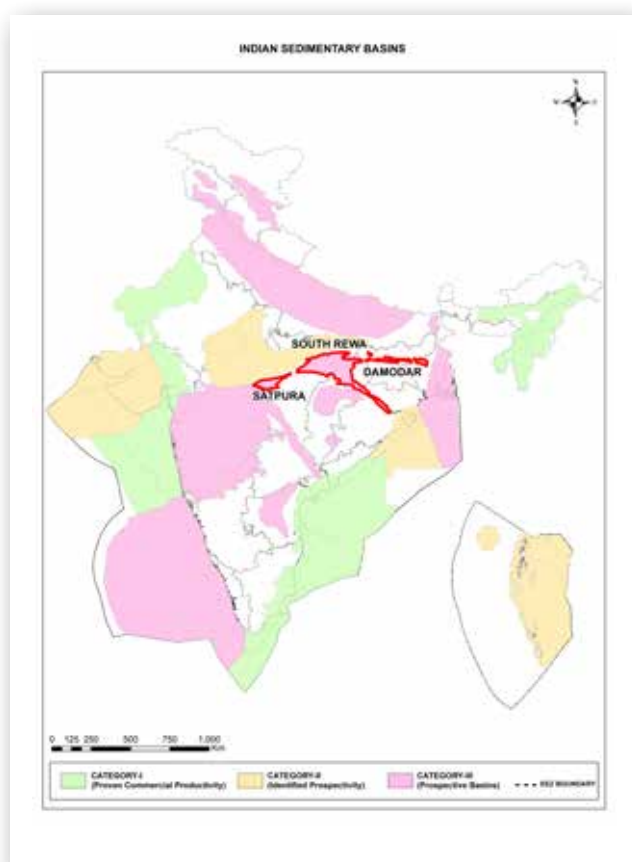
8. SATPURA-SOUTH REWA-DAMODAR BASIN

Satpura-South Rewa-Damodar is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery. The basin, however is commercially producing unconventional resource like coal bed methane.

Satpura sub-basin partially overlaps with the state of Madhya Pradesh.

South Rewa sub-basin partially overlaps with the state(s) of Chhattisgarh, Madhya Pradesh, Odisha and Uttar Pradesh.

Damodar sub-basin partially overlaps with the state(s) of Jharkhand and West Bengal.



Source: DGH Internal

The Gondwana rocks of Satpura-South Rewa-Damodar Basin are exposed along a linear belt in Indian peninsular region.

The basin has limited geoscientific data, specific to exploration of conventional hydrocarbons. The elements of conventional petroleum system in the basin are largely speculative.

The basin has Gondwana sediments - both Lower Permian plays and the Upper Mesozoic.



Source: DGH Internal

The basin has the close analogy with Cooper Basin of Australia. The study envisages the hypothetical Gondwana petroleum system, which, based on geological rationales is considered to be a close analogue with the Cooper Basin of Australia. There are three plays identified. viz. Early Permian, Mid. to Late Permian and Triassic to Cretaceous across all three sub-basins viz. Satpura, South Rewa and Damodar.

Instances of igneous intrusions call for an integrated approach during mapping hydrocarbon resources.

Source rock is Barakar and Bijori/ Raniganj Formation of Permian period with TOC 2.44 to 6.4%. Out of the three basins, average organic content in Damodar basin is highest (6.06-6.4 % from Raniganj and Barren Measures) with Type III organic matter with sandstone reservoirs of Permian to Triassic (Barakar/Raniganj/Panchet).



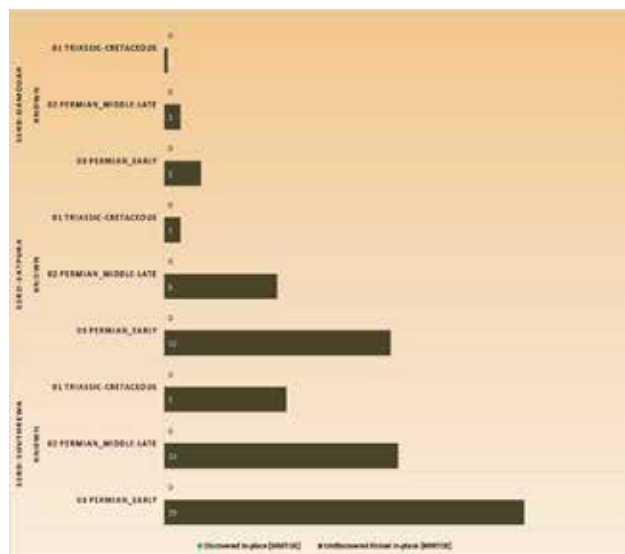
Hydrocarbon prospectivity and Basin maturity:

In the basin, Satpura has Early Permian-to-Cretaceous play. South Rewa has Early Permian-to-Cretaceous and Damodar Early Permian-to-Triassic. In 3 subbasins of Satpura, South Rewa and Damodar, Aerial Yield method was used on analogy of Cooper Basin

Satpura sub-basin has a total hydrocarbon in-place of 19 MMTOE and this is entirely undiscovered risked in- place.

South Rewa sub-basin has a total hydrocarbon in-place of 39 MMTOE and this is entirely undiscovered risked in-place.

Damodar sub-basin has a total hydrocarbon in-place of 3 MMTOE and this is entirely undiscovered risked in- place.



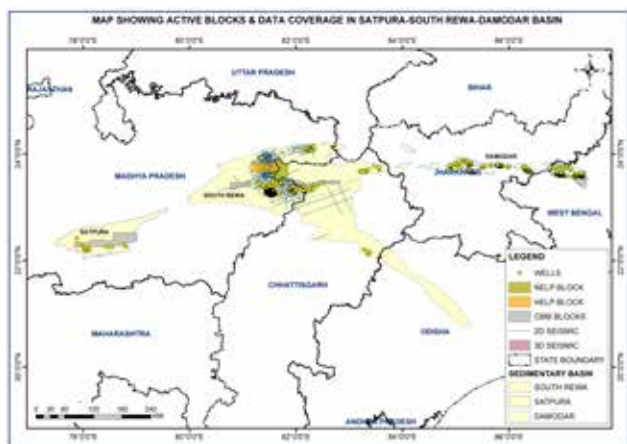
Source: DGH Internal

Overview of producing fields:

Commercial production in South Rewa sub-basin commenced in 2011. Major producing fields with cumulative production in parenthesis are namely Sohagpur-West (2 BCM) The sub-basin has 2 fields with 364 wells. The maximum flow rates achieved by any field on record in 2023-24 is, Gas 0.7 MMSCMD.

Commercial production in Damodar sub-basin commenced in 2008. Major producing fields with cumulative production in parenthesis are namely Raniganj-East (2.5 BCM), Raniganj-South (1.7 BCM) The sub-basin has 5 fields with 558 wells. The maximum flow rates achieved by any field on record in 2023-24 is, Gas 1 MMSCMD.

Basin datasets, studies and opportunities:



Source: DGH Internal

As of 31.03.2024, NDR has archived data of 30,090 LKM 2D seismic, 550 SKM 3D seismic and 1,053 wells.

Under various campaigns by GoI, geophysical data were acquired in onland area. Under National Seismic Programme (NSP), 1,142 LKM 2D seismic data were acquired.

IIT-ISM, Dhanbad, India has completed an independent assessment of CBM potential. Central Mine Planning and Design Institute, Ranchi, India is at proposal stage for assessment of CBM potential including core hole drilling.



Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
South Rewa	44,667	17,562 (39%)	NELP: 790 OALP: 906 CBM: 2,958
Satpura	7,890	2,632 (33%)	CBM: 1,440
Damodar	4,623	4,623 (100%)	CBM: 1,146

The basin occupies an area of 57,180 sq km. It has been appraised to the extent of 24,817 sq km. (43%). The active area under operation across regime(s) stands at 7,240 sq. km.

Current Bidding Opportunities:

Damodar

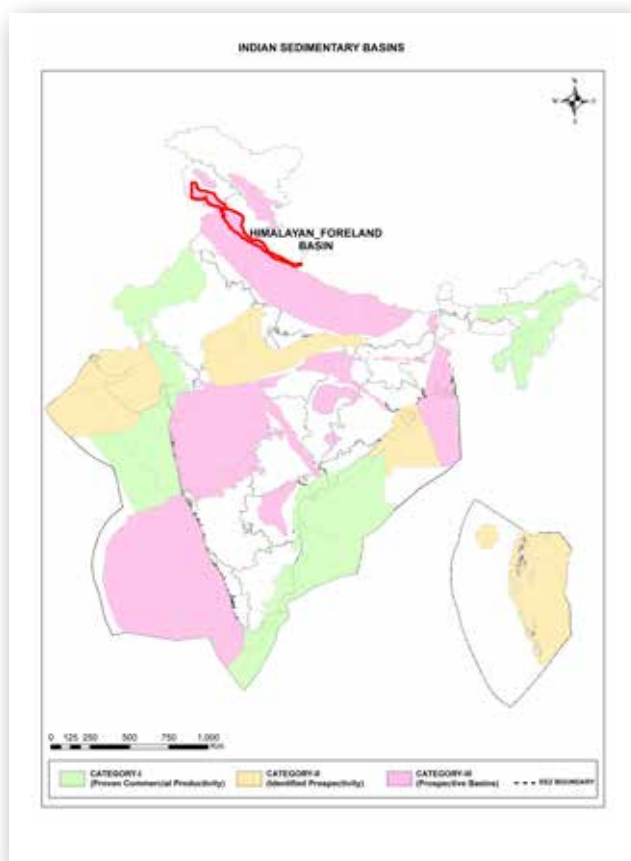
1 CBM block with 16 sq km area



9. HIMALAYAN FORELAND BASIN

Himalayan Foreland is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery.

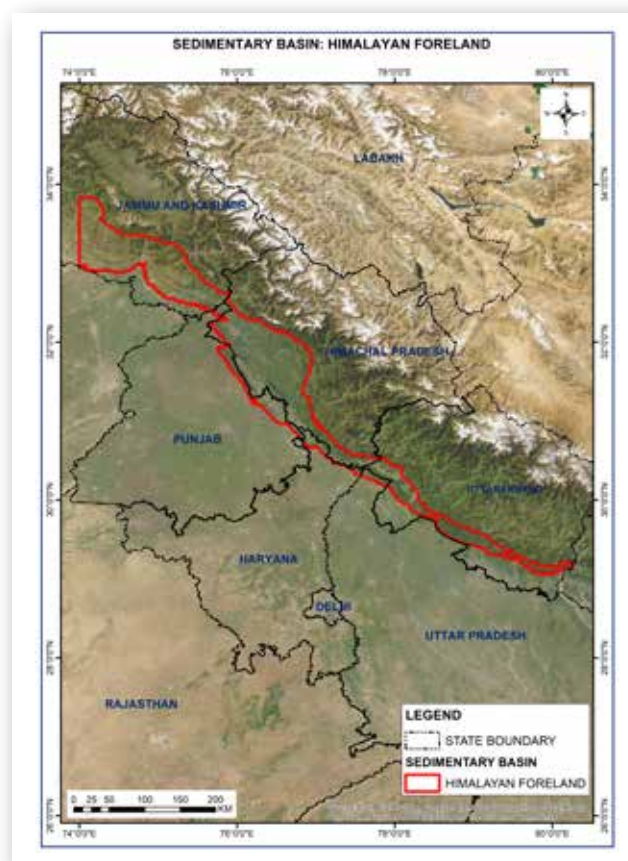
The geographical area of the basin partially overlaps with the state(s) of Chandigarh, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, Uttar Pradesh and Uttarakhand.



Source: DGH Internal

Himalayan foreland basin is an east-west trending elongate basin that extends from Pakistan in the west to India in the east. The basin came into existence at the close of Mesozoic Era following the first India-Asia impingement, resulting in the deposition of the initial foredeep sediments in front of the rising Himalaya.

Hydrocarbon exploration in Himalayan Foothills of erstwhile-named Punjab Basin was initiated in 1956 by M/s ONGC. Under geophysical campaign, aeromagnetic surveys were conducted in 1957, which was followed by seismic and gravity-magnetic (GM) surveys in 1957-58. Major part of the basin is covered by GM surveys. Such surveys bring out clearly that northwest-southeast Himalayan trend



Source: DGH Internal

is the dominant lineament in the basement. However, there is a strong perception of northeast-southwest Aravalli trend in the area lying between Kalka and Dehradun.

The basin has the close analogy with Potwar Basin of Pakistan. Poonch-Ravi sector, Doon Sector and Rishikesh-Tanakpur sector call for conceptual analysis in view of data gaps.

The source rocks identified are Proterozoic limestone having moderately good TOC of 0.52-1.58%. While Subathu shales have poor organic matter content, the Eo-Cambrian shales are perceived to be equivalent to Salt range Formation that has reported TOC of 23 %. The reservoirs are limestone of Vaishnodevi and Subathu Group and sandstones of Dharamsala/Muree Group.



Hydrocarbon prospectivity and Basin maturity:

In the basin, 4 plays are identified within Pre-Cambrian, Tertiary and Pleistocene.

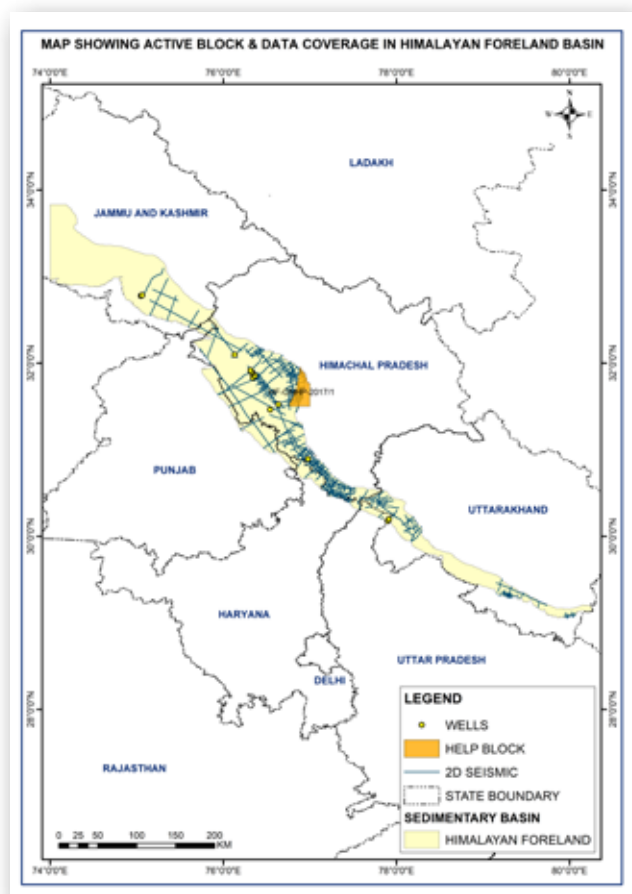
10,000m of sedimentary thickness was envisaged in the basin.

Aerial Yield method was used on analogy of Kohat Potwar Basin (Pakistan).

Himalayan Foreland basin has a total hydrocarbon in- place of 46 MMTOE and this is entirely undiscovered risked in-place.



Source: DGH Internal



Source: DGH Internal

Basin datasets, studies and opportunities:

As of 31.03.2024, NDR has archived data of 8,299 LKM 2D seismic and 17 wells.

Under various campaigns by GoI, geophysical data were acquired in onland area.

Under National Seismic Programme (NSP), 1,564 LKM 2D seismic data were acquired.



Basin appraisal and active acreage:

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	30,110	18,068 (60%)	OALP: 390

The basin occupies an area of 30,110 sq km. It has been appraised to the extent of 18,068 sq km. (60%). The active area under operation across regime(s) stands at 390 sq. km.

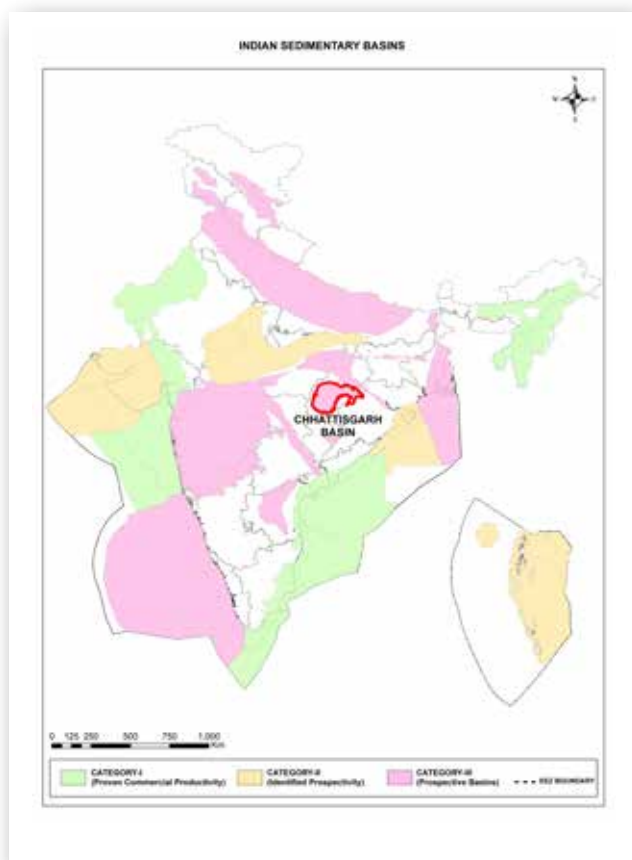
Current Bidding Opportunities:

Onland	1 OALP block with 991 sq km area
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10. CHHATTISGARH BASIN

Chhattisgarh is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery.

The geographical area of the basin partially overlaps with the state(s) of Chhattisgarh and Odisha.



Source: DGH Internal



Source: DGH Internal

The basin is located over the Bastar craton of Peninsular India.

The elements of petroleum system in the basin are largely speculative.

Entire Proterozoic sequence of the basin has been considered as a single Proterozoic Play and sub-divided into four assessment units based on geological rationales.



The basin has close analogy with Vindhyan Basin.

The expected major source rock is the black shales that show evidence of good organic matter, along with intercalated shale-limestone

of the Chhattisgarh basin that were deposited in basin slope to platform environment. The fractured and arenaceous Bhalukona Formation is expected to be reservoir rocks deposited in shallow marine environment.

Hydrocarbon prospectivity and Basin maturity:

In the basin, 1 play is known in Pre-Cambrian. 2,500m of sedimentary thickness was envisaged in the basin. Aerial Yield approach has been used on analogy of Vindhyan Basin.

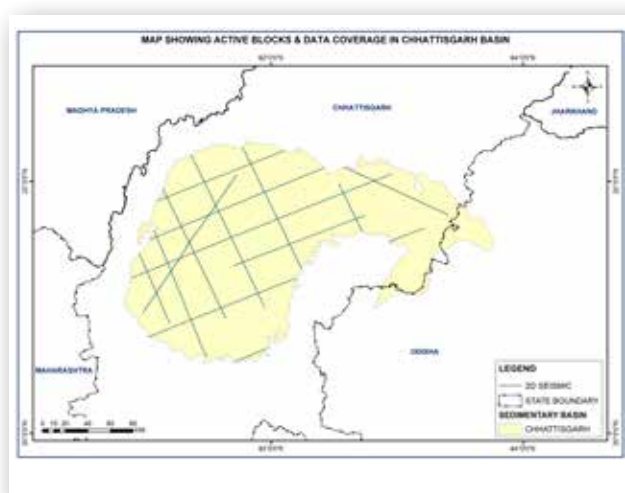
Chhattisgarh basin has a total hydrocarbon in-place of 25 MMTOE and this is entirely undiscovered risked in- place.

Basin datasets, studies and opportunities:

As of 31.03.2024, NDR has archived data of 3,330 LKM 2D seismic.

Under various campaigns by GoI, geophysical data were acquired in onland area. Under National Seismic Programme (NSP), 1,778 LKM 2D seismic data were acquired.

In another initiative, titled Mission Anveshan 1,150 LKM 2D seismic are planned as an in-fill data acquisition campaign of NSP.



Source: DGH Internal

Basin appraisal and active acreage:

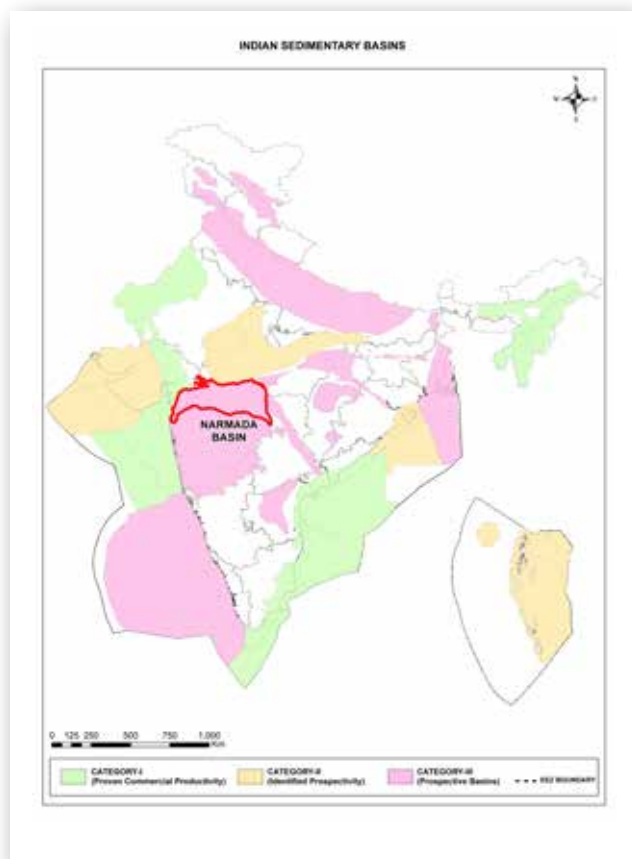
Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	32,000	32,000 (100%)	No active acreage

The basin occupies an area of 32,000 sq km. It has been appraised to the extent of 32,000 sq km. (100%)



11. NARMADA BASIN

Narmada is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery.



Source: DGH Internal

The basin is located in the northwestern part of Indian Peninsula and it extends up to the eastern limit of Cambay Basin while eastward it merges with the western boundary of Satpura.

The elements of petroleum system in the basin are largely speculative.

Based on Gravity and DSS data, sedimentary thickness of the basin is envisaged to be in the range of 300 m to 2.0 kms.

The basin has the close analogy with Cooper Basin of Australia. The basin has Pre-Trappean Gondwana play, which is divided into four assessment units based on available geological rationales.

The geographical area of the basin partially overlaps with the state(s) of Dadra and Nagar Haveli, Daman and Diu, Gujarat, Madhya Pradesh, Maharashtra and Telangana.



Source: DGH Internal

Basin is largely covered by Deccan trap basalts. Sub-trappean sediments are the focus area of exploration.

The hydrocarbon potential of Narmada Basin is envisaged mainly based on MT and DSS data in absence of conventional seismic and deep drilling information. Based on analogy of Satpura Basin, The Gondwana shale and limestone are expected source rocks. Reservoir rocks are envisaged to be Nimar sandstone and Bagh limestone along with Gondwana sediments.

Hydrocarbon prospectivity and Basin maturity:

In the basin, 1 play is identified within sub-trappean Gondwana. 400-1,500m of sedimentary thickness was envisaged in the basin. Aerial Yield method was used on analogy of Cooper Basin, Australia.

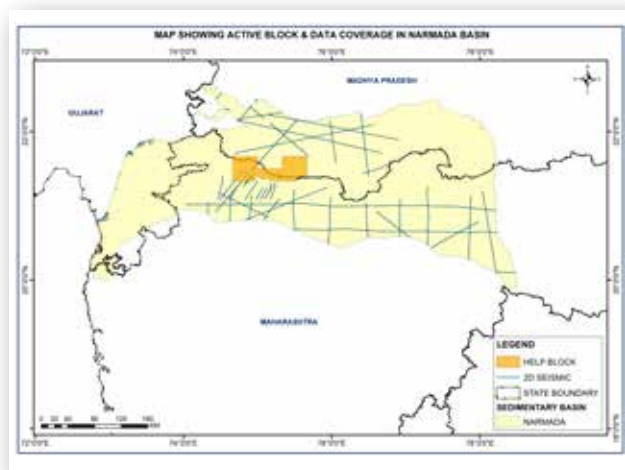
Narmada basin has a total hydrocarbon in-place of 9 MMTOE and this is entirely undiscovered risked in-place.



Basin datasets, studies and opportunities:

As of 31.03.2024, NDR has archived data of 11,400 LKM 2D seismic, 37 SKM 3D seismic.

Under various campaigns by GoI, geophysical data were acquired in onland area. Under National Seismic Programme (NSP), 1,618 LKM 2D seismic data were acquired.



Source: DGH Internal

Location	Basin area (skm)	Appraised (skm)	Active area across regime
Onland	95,215	24,960 (26%)	OALP: 2,999

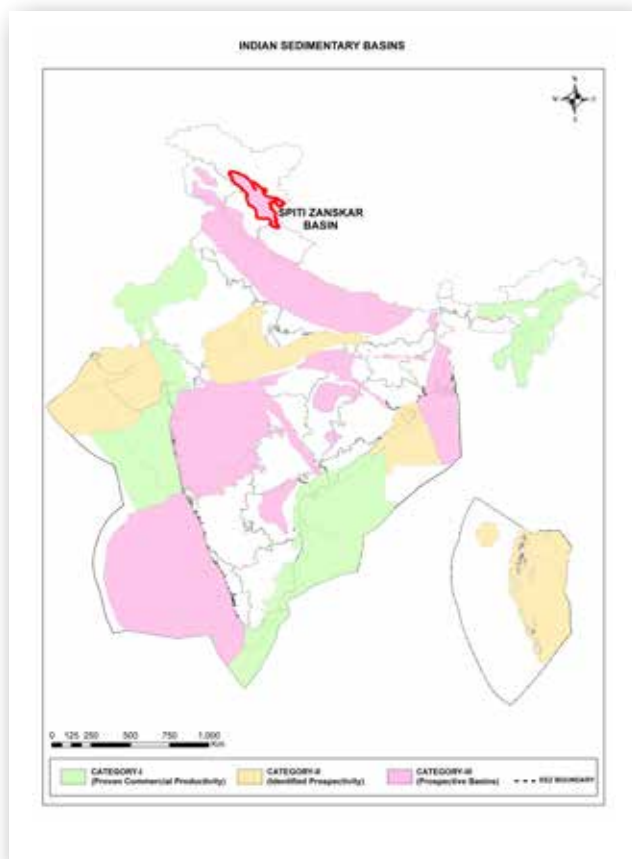
The basin occupies an area of 95,215 sq km. It has been appraised to the extent of 24,960 sq km. (26%). The active area under operation across regime(s) stands at 2,999 sq. km.



12. SPITI-ZANKSKAR BASIN

Spiti-Zankskar is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery.

The geographical area of the basin partially overlaps with the state(s) of Himachal Pradesh, Jammu and Kashmir and Uttarakhand.



Source: DGH Internal

The basin is situated within north-northwestern Himalayan Mountains along northern margin of India. The Basin exposes about 11,000 metre of Paleozoic, Mesozoic and a part of Lower Tertiary sediments.

The elements of petroleum system in the basin are speculative. The basin comprises of sedimentary sequence of Precambrian to Eocene age.

The basin has the close analogy with Potwar Basin of Pakistan. The Paleozoic and Mesozoic Plays of the Potwar Basin of Pakistan are used in the analogue study. These plays have four assessment units identified based on geological rationales.



Source: DGH Internal

The basin has inherent complex structure, which calls for detail study for identifying probable entrapment.

The Paleozoic shales of Carboniferous Po Formation, Late Permian Gungri Formation and Middle Devonian Lipak Formation having limestone-shale sequence (Minor Source) along with Mesozoic Shale are potential source rocks with average TOC 1.72%. The envisaged reservoirs are sandstone-conglomerates and limestones belonging to Paleozoic to Late Mesozoic. The Intermittent shales of the Paleozoic and Mesozoic sequence, wherever regionally continuous are believed to act as seals. The presence of several large anticlines, synclines, and fault-related folds could be possible entrapment.



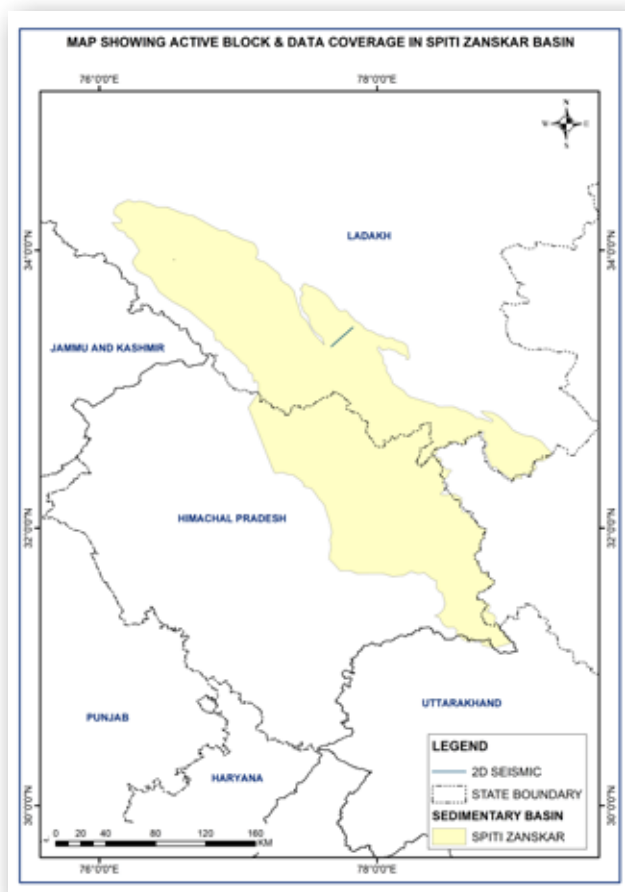
Hydrocarbon prospectivity and Basin maturity:

In the basin, 2 plays are present within Paleozoic and Mesozoic. 11,000m of sedimentary sequence was envisaged in the basin. Aerial Yield method was used on analogy of Kohat Potwar Basin (Pakistan).

Spiti-Zaskar basin has a total hydrocarbon in-place of 10 MMTOE and this is entirely undiscovered risked in-place.

Basin datasets, studies and opportunities:

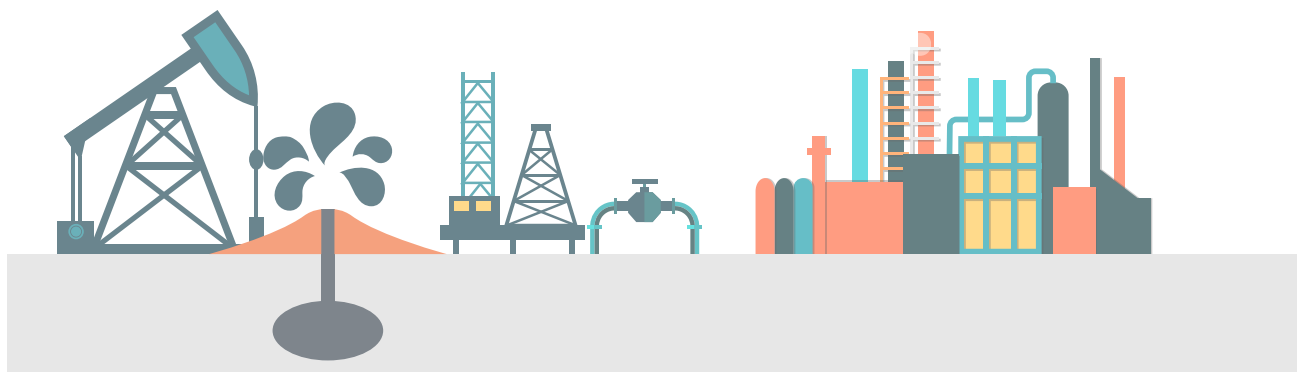
As of 31.03.2024, NDR has archived data of 42 LKM 2D seismic.



Source: DGH Internal

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	32,000	0 (%)	No active acreage

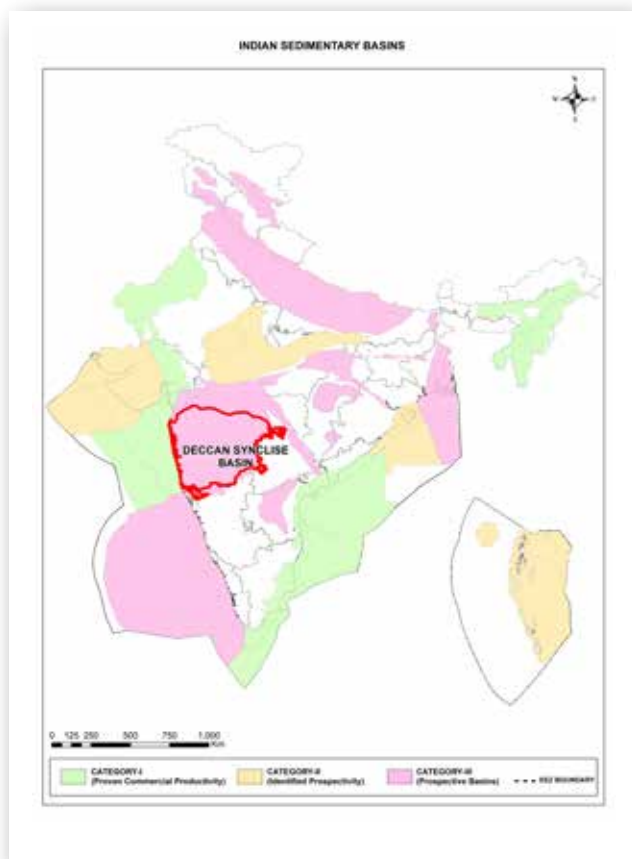
The basin occupies an area of 32,000 sq km.



13. DECCAN SYNECLISE BASIN

Deccan Syneclise is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery.

The geographical area of the basin partially overlaps with the state(s) of Dadra and Nagar Haveli, Goa, Gujarat, Karnataka, Maharashtra and Telangana.



Source: DGH Internal

Deccan Syneclise basin is located in the western and south-central part of India. The large part of the basin is underlain by Deccan basalts.

The elements of petroleum system in the basin are speculative. Based on gravity and DSS data about 1.5-2.0 Km thick sediments are speculated to be present underneath Deccan Trap basalts.

The basin has the close analogy with Cooper Basin of Australia and Vindhyan Basin. The inferred geological history of this area favours presence of Pre-Trappean Gondwana and



Source: DGH Internal

Proterozoic sequences in the area. The basin has been divided into three assessment units on the basis of tectonics. Two units in north-east being proximal to Satpura Basin may represent Pre-Trappean Gondwana sequence whereas the third unit represents the Proterozoic sequence.

Sub-basalt imaging to study sub-trappean sediments is the focus area.

Two petroleum systems are speculated, and the envisaged elements of petroleum system is suggestive of dark gray shales and marls of Lower Gondwana rocks containing abundant organic matter as the source rock.

Additionally, the Meso-to-Neo-Proterozoic and Late Cretaceous shale and carbonate may act as source rocks with Lower Gondwana / Mesoproterozoic arenaceous, and carbonate rocks may act as reservoir. The intra-formational shales and the Trap flows may provide extensive seal across the basin.



Hydrocarbon prospectivity and Basin maturity:

In the basin, 2 plays exist within Precambrian and Late Paleozoic (Gondwana). 1,500m sedimentary thickness was envisaged in the basin. Aerial Yield method was used on analogy

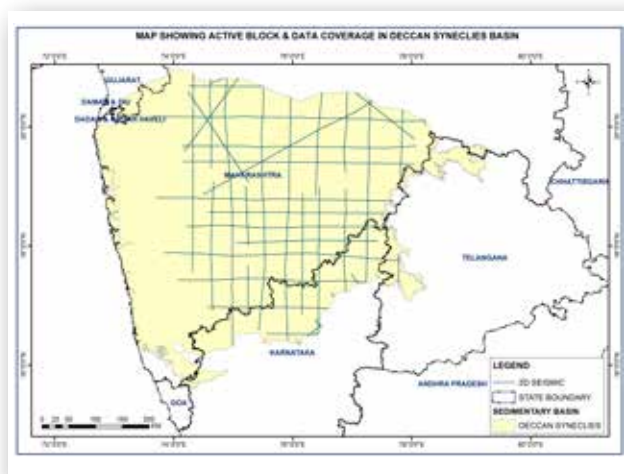
of Vindhyan Basin (Pre-Cambrian) and Cooper Basin, Australia (Gondwana). Deccan Syneclise basin has a total hydrocarbon in- place of 12 MMTOE and this is entirely undiscovered risked in-place.

Basin datasets, studies and opportunities:

As of 31.03.2024, NDR has archived data of 43,842 LKM 2D seismic.

Under various campaigns by GoI, geophysical data were acquired in onland area. Under National Seismic Programme (NSP), 10,436 LKM 2D seismic data were acquired.

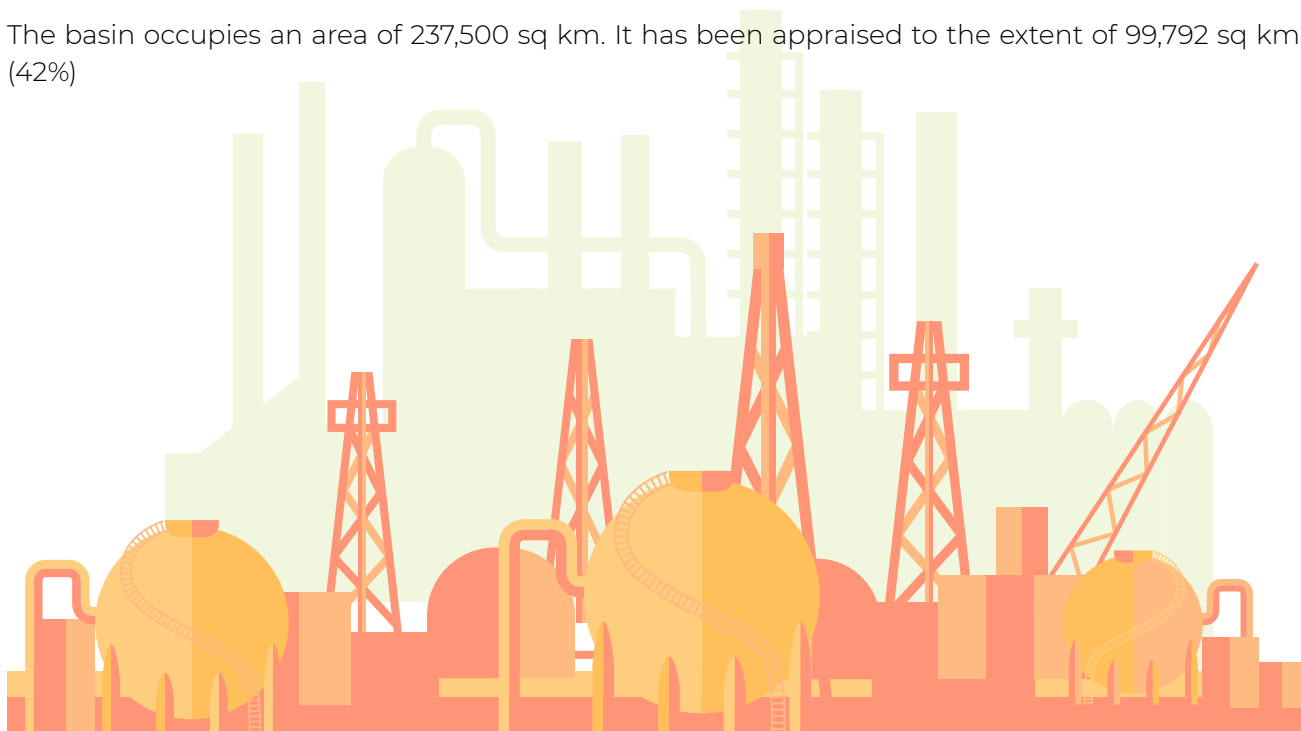
In another initiative, titled Mission Anveshan 2,004 LKM 2D seismic are planned as an in-fill data acquisition campaign of NSP.



Source: DGH Internal

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	237,500	99,792 (42%)	No active acreage

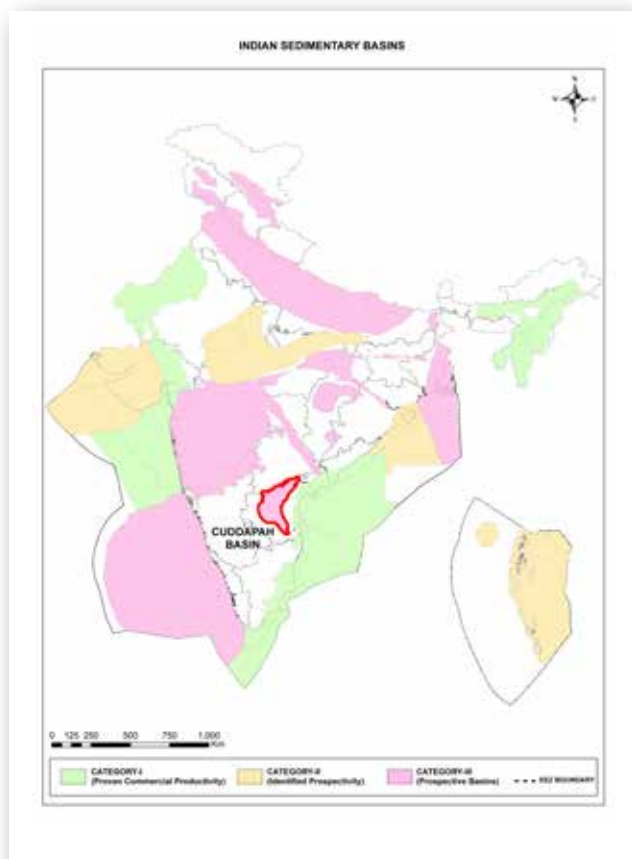
The basin occupies an area of 237,500 sq km. It has been appraised to the extent of 99,792 sq km. (42%)



14. CUDDAPAH BASIN

Cuddapah is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery.

The geographical area of the basin partially overlaps with the state(s) of Andhra Pradesh and Telangana.



Source: DGH Internal



Source: DGH Internal

Cuddapah is a crescent-shaped basin, located in the eastern part of Dharwar craton. The elements of petroleum system in the basin are speculative.

The basin with Paleo- to-Neoproterozoic age has stratigraphic thickness ranging 6 to 12 km.

The basin has the close analogy with Vindhyan Basin. The Paleo-to-Meso-Proterozoic Basuhari-Rohtas play of Vindhyan Basin is the close analogue. Entire Proterozoic sequence of the basin is considered a single Proterozoic Play,

subdivided into five assessment units based on geological rationales.

A speculative Proterozoic petroleum System has been envisaged in view of absence of subsurface data based on the closest analogy of the Paleo-to-Meso-Proterozoic Basuhari-Rohtas play of Vindhyan Basin. Sandstones having Secondary porosity (fractures) are reservoirs. The intervening shale within the sedimentary sequence may act as an effective seal. Cumbum Shales, Tadpatri Shales & Vempalle Stromatolitic Dolomite are source. Entrapment is structural like anticlines and fault closures.



Hydrocarbon prospectivity and Basin maturity:

In the basin, 1 play is known within Pre-Cambrian. 6,000-10,000m sedimentary thickness was envisaged in the basin. Aerial Yield method was used on analogy of Vindhyan Basin.

Cuddapah basin has a total hydrocarbon in-place of 5 MMTOE and this is entirely undiscovered risked in- place.

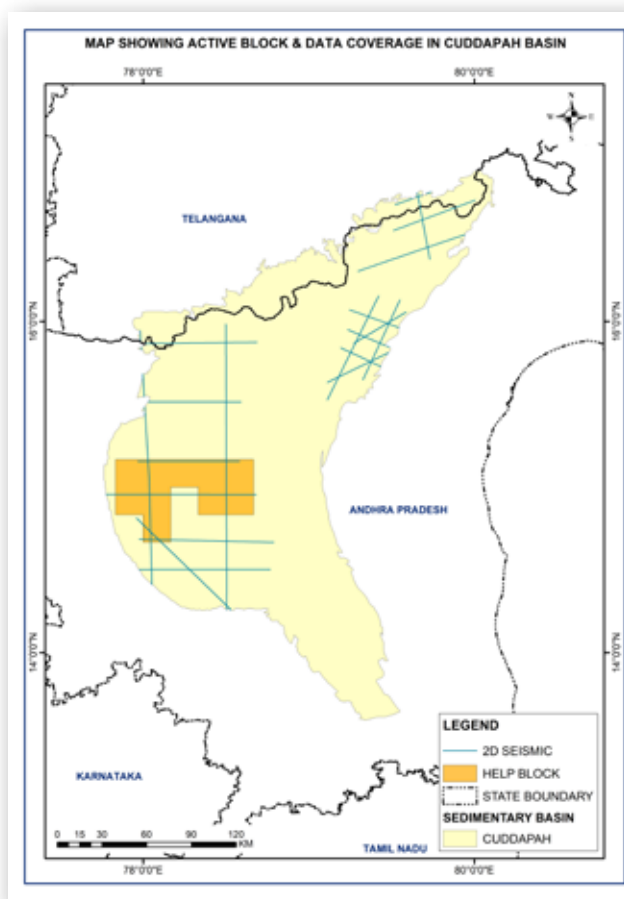
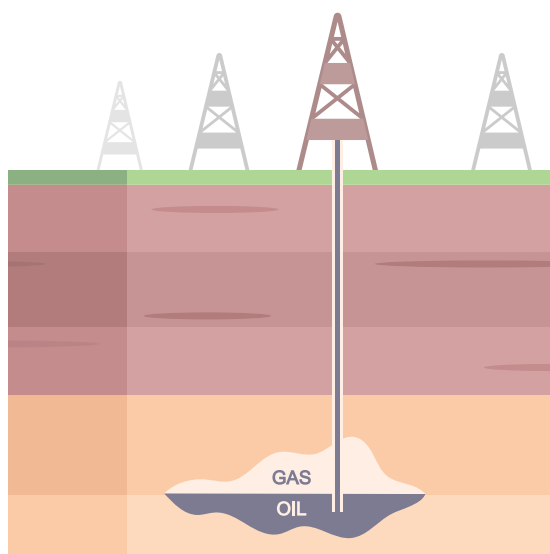
Basin datasets, studies and opportunities:

As of 31.03.2024, NDR has archived data of 2,771 LKM 2D seismic.

Under various campaigns by GoI, geophysical data were acquired in onland area.

Under National Seismic Programme (NSP), 1,387 LKM 2D seismic data were acquired.

In another initiative, titled Mission Anveshan 2,500 LKM 2D seismic are planned as an in-fill data acquisition campaign of NSP.



Source: DGH Internal

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	40,100	11,760 (29%)	OALP: 3,306

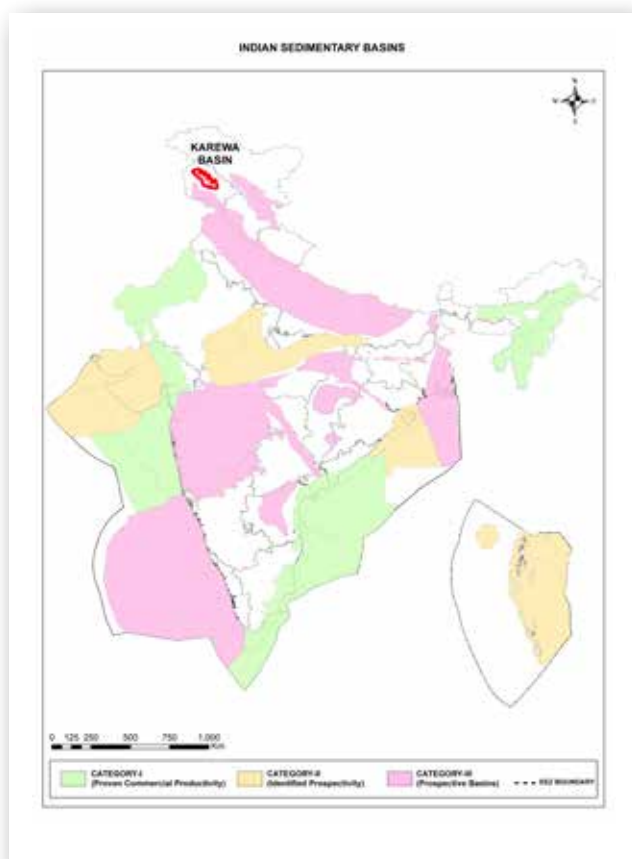
The basin occupies an area of 40,100 sq km. It has been appraised to the extent of 11,760 (29%) sq km. (42%). The active area under operation across regime(s) stands at 3,306 Sq.km



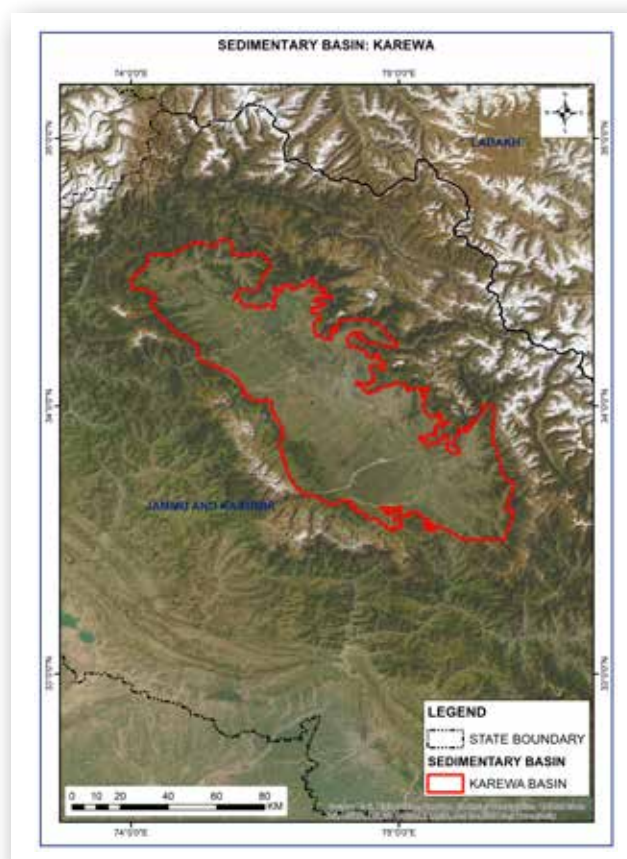
15. KAREWA BASIN

Karewa is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery.

The geographical area of the basin partially overlaps with the state(s) of Jammu and Kashmir.



Source: DGH Internal



Source: DGH Internal

Karewa is an intermontane basin, located in Kashmir valley of northwestern Himalayas. It is an oval-shaped basin between Pir-Panjal Range in the southwest and Zaskar Range to its northeast.

The elements of petroleum system in the basin are largely speculative.

The basin has the close analogy with Potwar Basin of Pakistan. The identified three plays viz. Paleozoic Play, Triassic Limestone Play and Plio-Pleistocene Play has six assessment units each.

The Mesozoic shales and carbonates are considered to have optimal TOC in the range

of 2.12-2.82% to act as source for the Devonian, Carboniferous, and Pliocene sediments.

Hydrocarbon prospectivity and Basin maturity:

In the basin, 3 plays are present within Paleozoic, Mesozoic and Plio-Pleistocene. Aerial Yield approach is used on analogy of Kohat Potwar Basin (Pakistan).

14,000m sedimentary thickness has been envisaged in the basin.

Karewa basin has a total hydrocarbon in-place of 6 MMTOE and this is entirely undiscovered risked in-place.

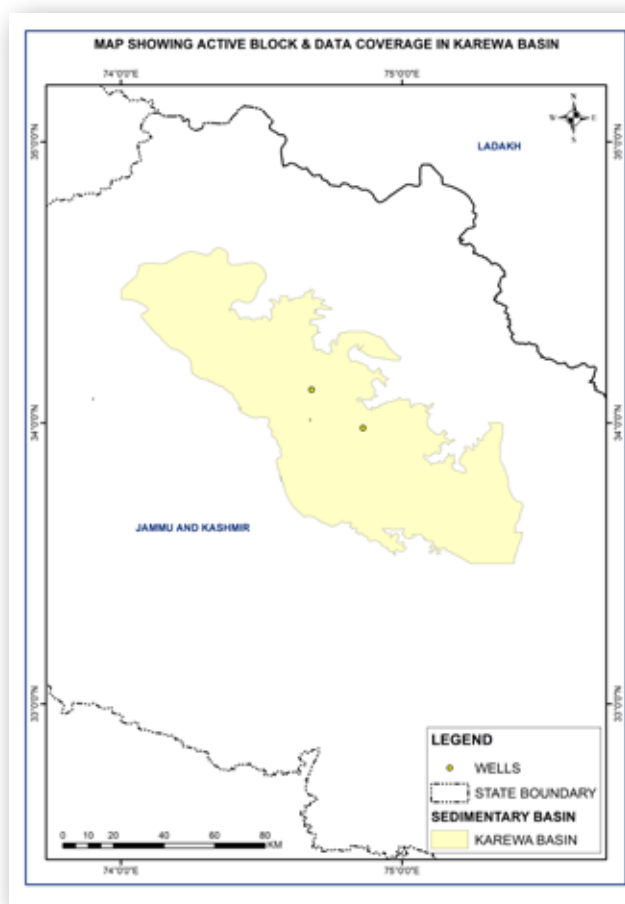
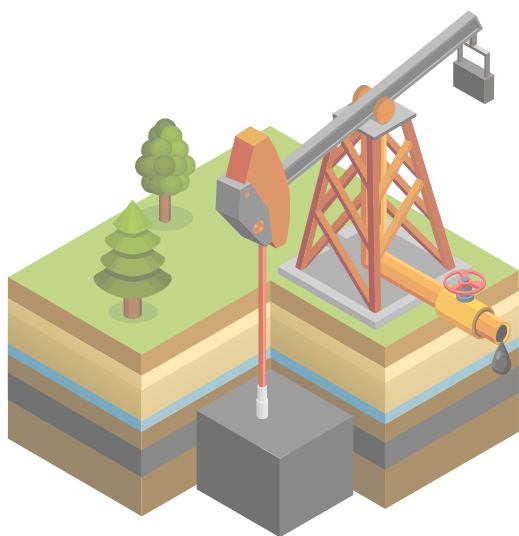


Basin datasets, studies and opportunities:

As of 31.03.2024, NDR has archived data of 2 wells.

Under various campaigns by GoI, geophysical data were acquired in onland area.

Under Air-borne Gravity-Gradiometry(AGG) survey, 1,817 FLKM data were acquired in inaccessible and operationally challenging areas where seismic survey under NSP couldnot be conducted.



Source: DGH Internal

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	6,671	555 (8%)	No active acreage

The basin occupies an area of 6,671 sq km. It has been appraised to the extent of 555 sq km. (8%)

Current Bidding Opportunities:

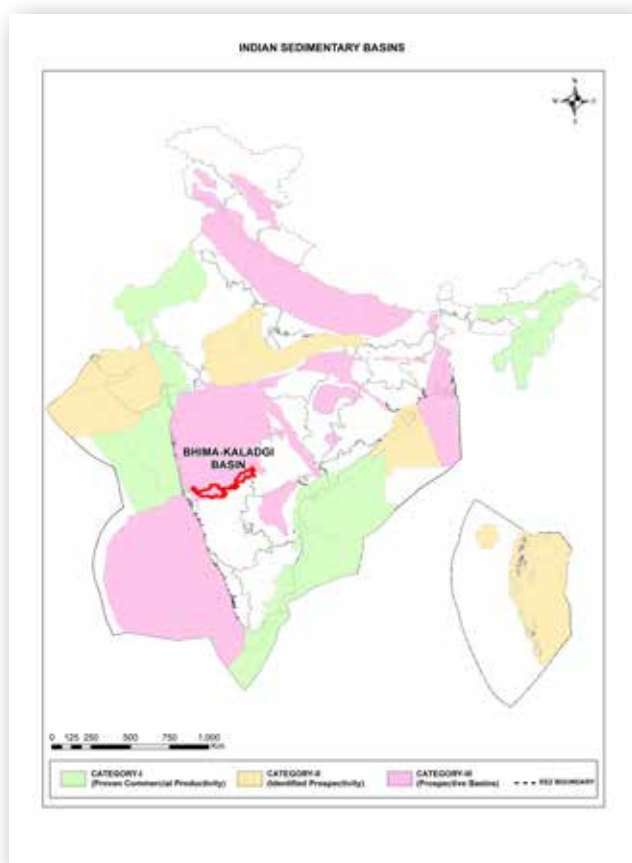
Onland	1 OALP block with 284 sq km area
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16. BHIMA-KALADGI BASIN

Bhima-Kaladgi is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery.

Bhima sub-basin partially overlaps with the state(s) of Karnataka and Telangana. Kaladgi sub-basin partially overlaps with the state(s) of Karnataka and Maharashtra.



Source: DGH Internal

Bhima-Kaladgi are two Proterozoic sub-basins situated over Dharwar craton. The elements of petroleum system in the basin are largely speculative.

Bhima sub-basin is characterized by Neo-Proterozoic sedimentary sequence of 250 m thickness whereas Kaladgi sub-basin is represented by 4,500 m thick Paleo-to-Neo-Proterozoic sediments. Entire Proterozoic



Source: DGH Internal

sequences in Bhima-Kaladgi Basin has been considered as single play, sub-divided into three assessment units each on the basis of their respective tectonic set-up.

The basin has the close analogy with Vindhyan Basin. Paleo-to-Meso-Proterozoic Basuhari-Rohtas play of Vindhyan Basin has been used in the analogue study.

Sub-basalt imaging to study sub-trappean sediments is the focus area.

Source rocks are thick successions of shale (argillite)-limestone (dolomite)/stromatolitic limestone rich in organic matter.

The Deccan Traps overlying the successions of these basins might have provided sufficient thermal conditions for hydrocarbon generation in the arenaceous and carbonate rocks of Baghalkot Group.



Hydrocarbon prospectivity and Basin maturity:

In the basin, 1 play is identified within Pre-Cambrian. Aerial Yield method was used on analogy of Vindhyan Basin. Sedimentary thickness of 270m (Bhima) and 3,000-4,500m (Kaladgi) were envisaged.

Bhima sub-basin has a total hydrocarbon in-place of 0 MMTOE and this is entirely undiscovered risked in- place.

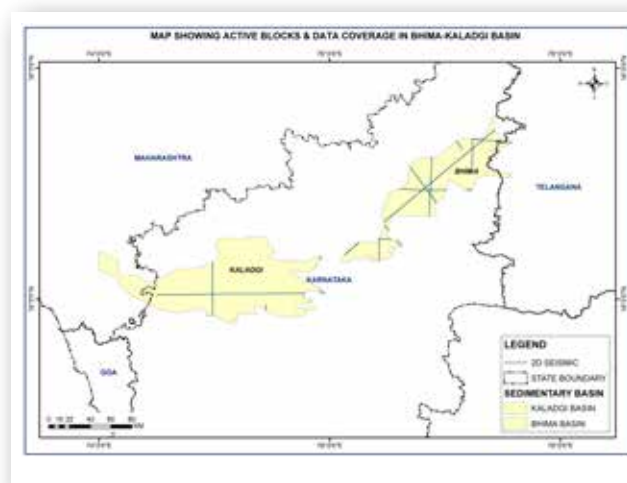
Kaladgi sub-basin has a total hydrocarbon in-place of 6 MMTOE and this is entirely undiscovered risked in- place

Basin datasets, studies and opportunities:

As of 31.03.2024, NDR has archived data of 3,102 LKM 2D seismic.

Under various campaigns by GoI, geophysical data were acquired in onland area.

Under National Seismic Programme (NSP), 869 LKM 2D seismic data were acquired.



Source: DGH Internal

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Kaladgi	8,820	0 (%)	No active acreage
Bhima	5,280	2,366 (45%)	No active acreage

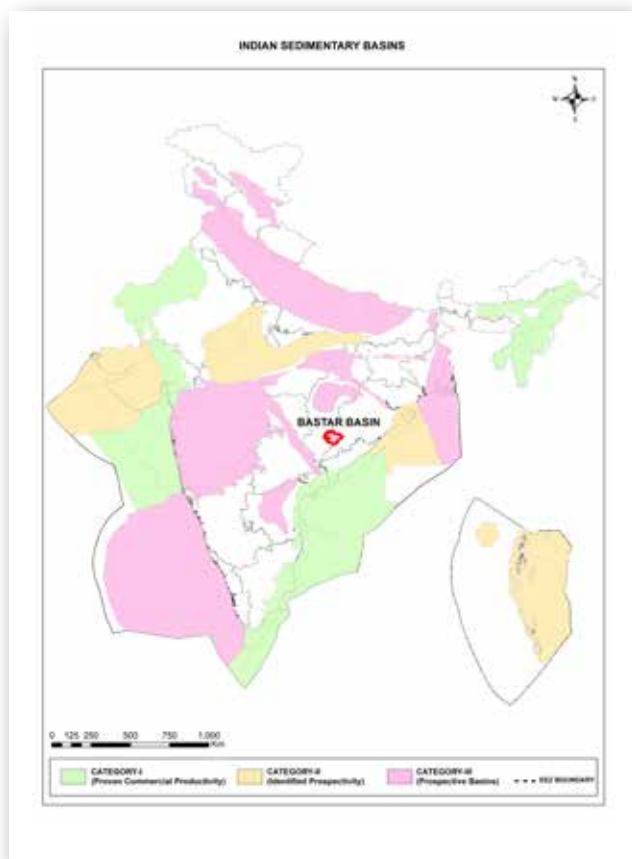
The basin occupies an area of 14,101 sq km. It has been appraised to the extent of 2,366 sq km. (17%)



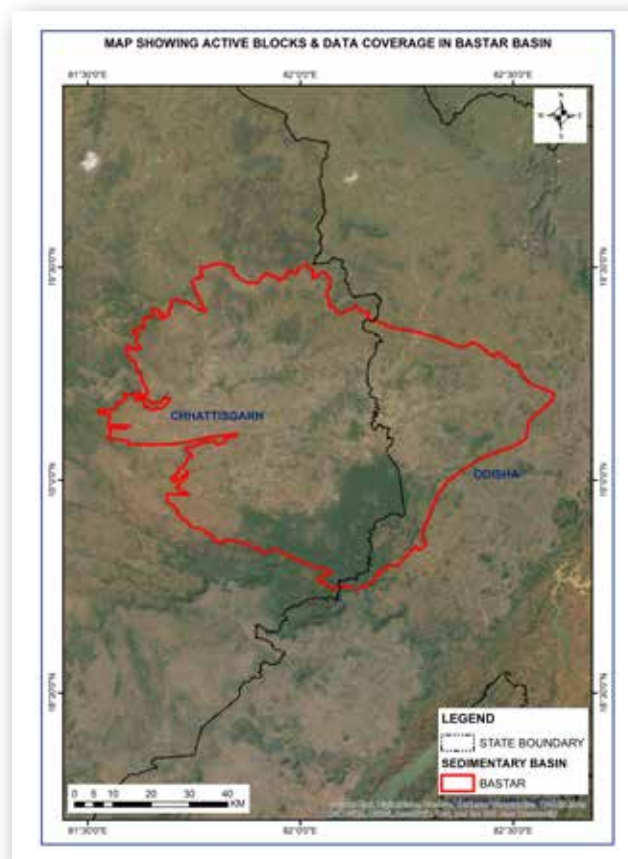
17. BASTAR BASIN

Bastar is a Category III basin, implying that the basin has entirely undiscovered inplace, that calls for intense exploration for a potential discovery.

The geographical area of the basin partially overlaps with the state(s) of Chhattisgarh and Odisha.



Source: DGH Internal



Source: DGH Internal

Bastar Basin, one amongst the several Proterozoic sedimentary basins is located over Peninsular India.

The elements of petroleum system in the basin are largely speculative.

The maximum sedimentary thickness of the basin is the order of 500-600 m. Entire Proterozoic sequence of the basin has been considered as a single play, sub-divided by a fault into two assessment units.

The basin has the close analogy with Vindhyan Basin. Paleo-to-Meso-Proterozoic Basuhari-Rohtas play of Vindhyan Basin has been used in the analogue study.

Assessment of thickness of sedimentary sequence is the focus area. The elements of petroleum system are not yet ascertained till date, but shale of Indravati Group has the potential to act as a source rock to the arkosic sandstone and carbonates that may be the possible reservoirs. Entrapment is expected to be structural in nature.



Hydrocarbon prospectivity and Basin maturity:

In the basin, 1 play is known within Pre-Cambrian. Aerial Yield method was used on analogy of Vindhyan Basin.

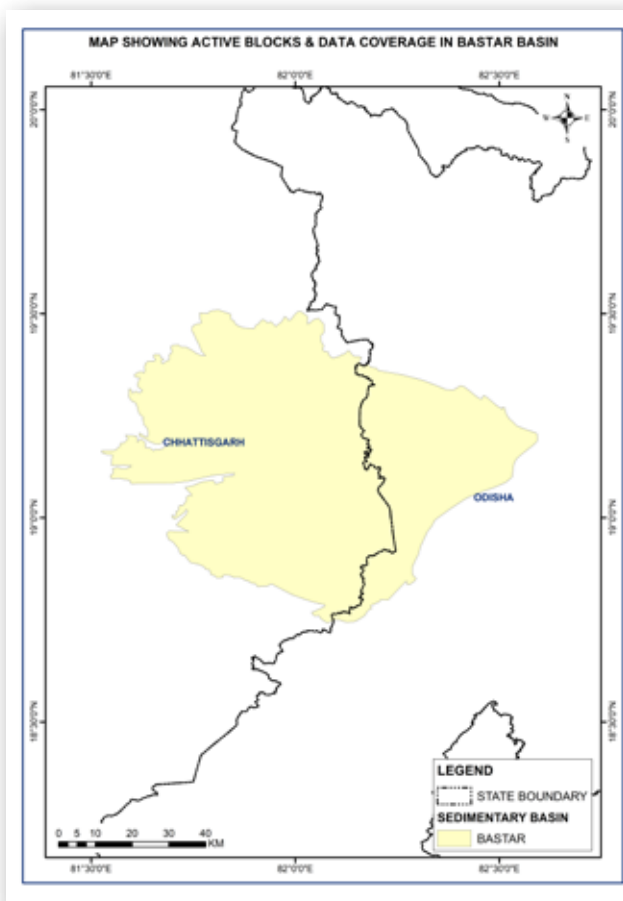
Bastar basin has a total hydrocarbon in-place of 1 MMTOE and this is entirely undiscovered risked in- place.

Basin datasets, studies and opportunities:

As of 31.03.2024, there is no seismic/well data available at NDR.

Under various campaigns by GoI, geophysical data were acquired in onland area.

Under Air-borne Gravity-Gradiometry(AGG) survey, 1,834 FLKM data were acquired in inaccessible and operationally challenging areas where seismic survey under NSP could not be conducted.



Source: DGH Internal

Location	Basin area (skm)	Appraised (skm)	Active area (skm) across regime
Onland	5,360	0 (%)	No active acreage

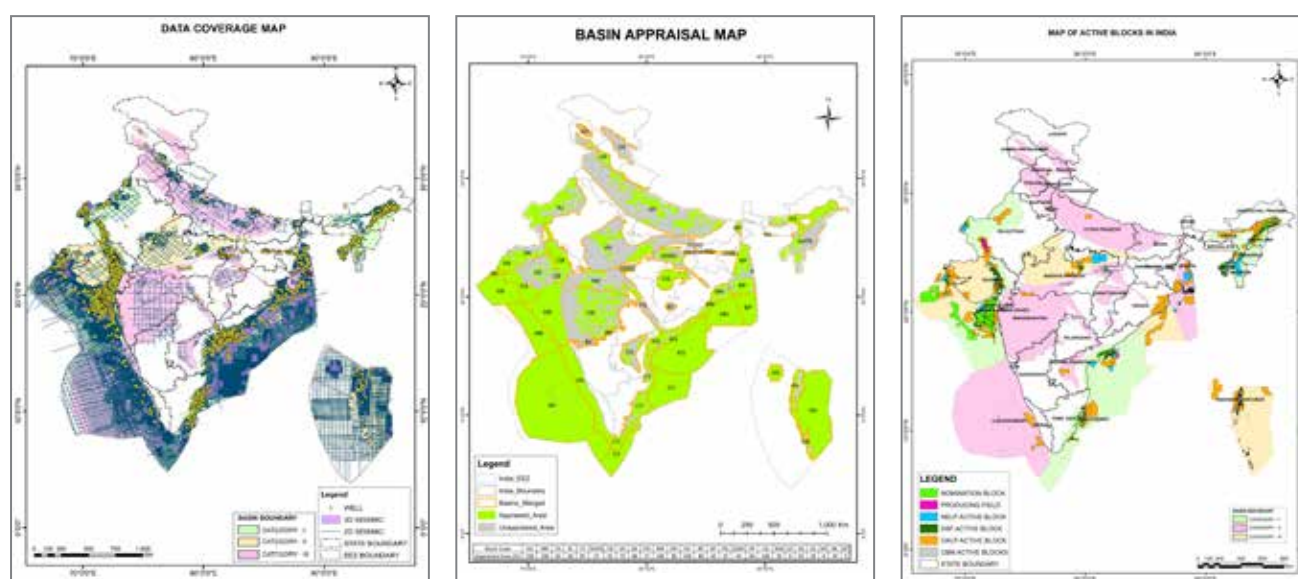
The basin occupies an area of 5,360 sq km.



COLLABORATIVE STUDIES AND OPPORTUNITIES IN ONLAND:

Like offshore, onland datasets are provided to Universities and Institutes as a part MoUs on basin research. Pandit Deendayal Petroleum University(PDEU), Gandhinagar carried out prospectivity study of Kutch and Saurashtra basins (both onland and offshore). In a similar scope, Rajiv Gandhi Institute of Petroleum Technology (RGPT), Amethi conducted prospectivity analysis of Ganga-Punjab and Vidhyan basins. DGH, as a part of collaborative studies of Indian basins had signed several MoUs with Geological Survey of India (GSI), Indian Institute of Technology(IIT)-Indian School of Mines(ISM), Dhanbad; Wadia Institute of Himalayan Geology (WIHG), Dehradun. Besides,

one MoU with Central Mine Planning and Design Institute(CMPDI), Ranchi is at proposal stage for unconventional CBM study including drilling of core holes. While GSI picked up research study in Bikaner-Nagaur subbasin and Cuddapah basin. WIHG chose Amguri field and adjoining areas of Assam Shelf basin to study tectonic anomaly using AI/ML technique. The institute had also conducted similar study in KG and Cambay basins pertaining to organic carbon assessment and flow rate study from production logs respectively. IIT-ISM has completed an independent assessment of CBM potential.



Source: DGH Internal

As of April 1, 2024, NDR has archived 3.7 million line km 2D seismic data, 1.2 million sq km 3D seismic data, 23,600+ wells and 49,700+ reports. These data include all value-added reprocessed variants along with 2D seismic data acquired under various Gol-sponsored campaign namely NSP(46,978 LKM), Andaman(22,564 LKM) and EEZ(79,540 LKM).

Out of 3.36 million sq km basin area, 2.45 million sq km (73%) has been appraised and 0.37 sq km area(11%) is active under different operating regimes.

As a part of Gol-sponsored initiatives, country-level assessment of conventional and unconventional hydrocarbons is currently formulated with proposed participation of NOCs and major private E&P Operators. Such study is expected to be software-agnostic and expert-reviewed with results integrated into a National Hydrocarbon Atlas

The Chapter herein presented is intended to give an overview of India's sedimentary basins with a summative reference to brief exploration history, key facts and studies, status of available datasets, including information of latest survey data, acquired and proposed under Gol's continued data acquisition programme.





3

Exploration and Production Activities



The substantial E&P efforts undertaken in 2014-24 have set the stage for sustained growth in the Indian E&P sector for years to come.

The Indian government's commitment to streamlining business regulations in the Exploration and Production (E&P) sector is evident in the recent wave of policy reforms. This focus on improving the Ease of Doing Business has led to a significant rise in E&P activity. This surge is expected to play a crucial role in achieving the government's ambitious goal of reducing dependence on imported hydrocarbons.

Recognizing that increased domestic oil and gas production is key to reducing import reliance, the government has prioritized boosting E&P activities. This includes offering more exploration acreage and discovered fields for development.

The substantial E&P efforts undertaken in 2014-24 have set the stage for sustained growth in the Indian E&P sector for years to come. This chapter provides a comprehensive overview of E&P activities during the 2023-24 fiscal year, including details and statistics on exploration, development, and production across the country.



3.1 Seismic Activities

In FY 2023-24, majority of the data acquisition was carried out under Nomination and RSC regime (in OALP Blocks). Total 3D seismic data acquired in FY 2023-24 was 15700.57 SKM Out of which approximately 8828 SKM data was acquired by NOCs under Nomination Regime while 6872 SKM were acquired by NOCs/JVs/ Pvt. companies under OALP.

This year the focus was on offshore basins which resulted in the 3D data acquisition of 10532.70 SKM (approximately 67 % of total 3D data acquisition), while 5167.87 SKM 3D seismic data was acquired in Onland area.

Details of exploratory activities in Nomination, PSC regime & RSC regime in FY 2023-24 are compiled in Table 3.1.

Table 3.1: Exploratory efforts in Nomination & PSC regime during FY 2023-24

Sl. No	Subject	Parameter	ONGC (Nomination)	OIL (Nomination)	Contract Regime (PSC+RSC+CBM)	Total
1	2D Seismic data acquired	Onland (GLKM)	971.81	0.0	1404	2375.81
		Offshore (GLKM)	0.0	0.0	0	0.0
	Total 2D Seismic		971.81	0.0	1404	2375.81
2	3D Seismic data acquired	Onland (SKM)	2334.30	240.57	2593	5167.87
		Offshore (SKM)	6253.70	0.0	4279	10532.7
	Total 3D Seismic		8588	240.57	6872	15700.57

3.2 Drilling Activities

During FY 2023-24, a total of 132 exploratory wells (including Onland and offshore) were drilled, while a total of 609 development wells were drilled by NOCs and Pvt./JVs. Majority of

the wells were drilled by ONGC in its onland nomination areas.

Country's Drilling activities are summarized in Table 3.2.

Table-3.2 Drilling Activities in Nomination & PSC regime during FY 2023-24

Sl. No	Subject	Parameter	ONGC (Nomination)	OIL (Nomination)	Contract Regime (PSC+RSC+CBM)	Total
1	Exploratory wells drilled	Onland	57	12	26	95
		Offshore	24	0	13	37
	Total Exploratory wells		81	12	39	132
2	Development wells	Onland	337	44	137	518
		Offshore	87	0	04	91
	Total Development wells		424	44	141	609



Yearwise Exploratory and Development Drilling performance is depicted in Figure 3.1 and Figure 3.2 respectively.

Figure 3.1: Year Wise Exploratory Wells Drilled

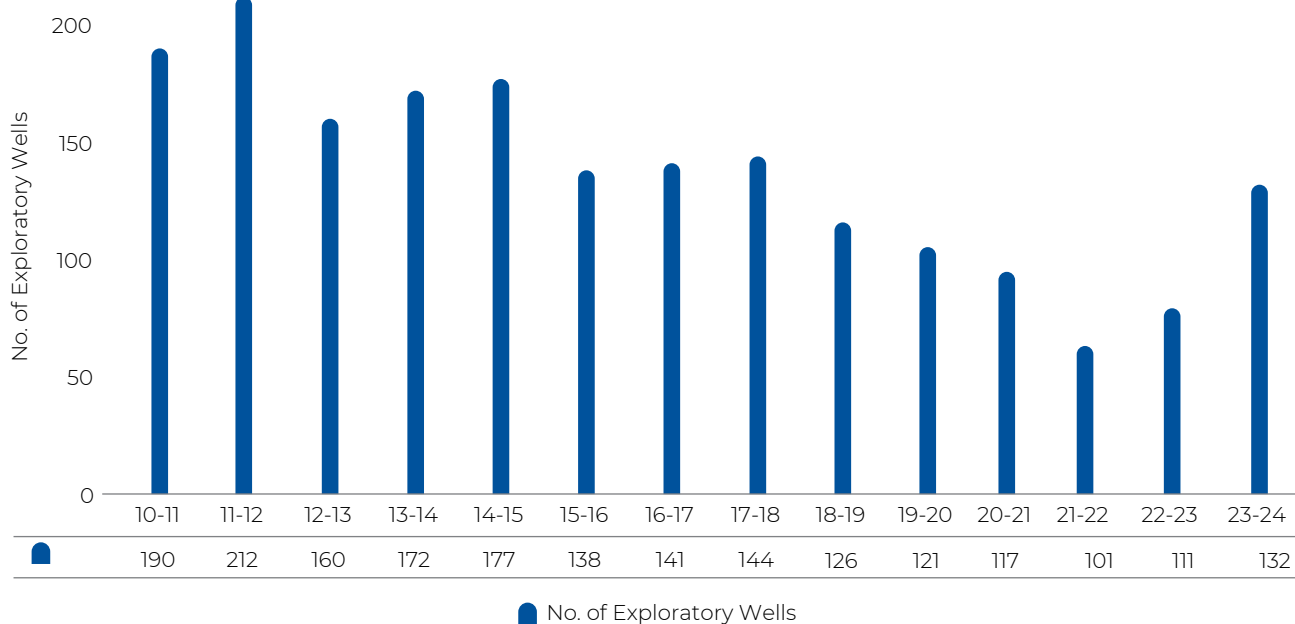
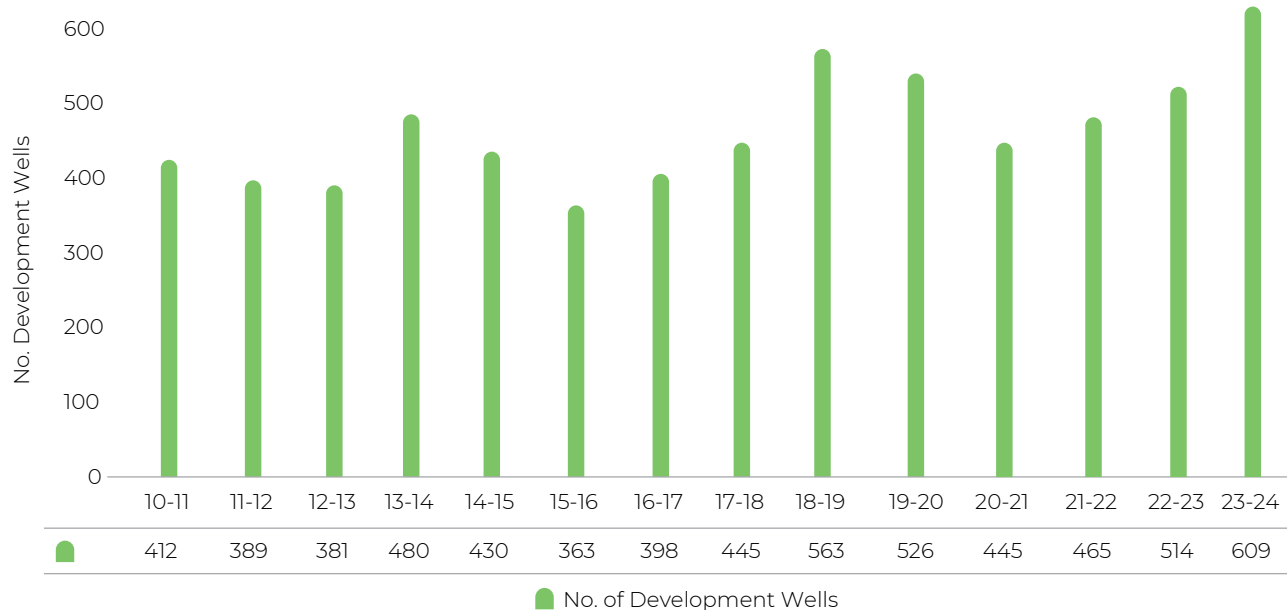


Figure 3.2: Year Wise Development Wells Drilled



3.3 Oil and Gas Production

In FY 2023-24 the country has achieved 97.8% of its crude oil production target by producing 29.36 MMT against crude production target of

30.003 MMT, while the domestic gas production stood at 36.44 BCM against the target of 38.181 BCM.

There was an increase in crude oil production by 0.6% and the gas production increased by 5.8% as compared to the previous year.

Table 3.4: Oil and Gas production in the country – 2023-24

Operator (Regimes)	OIL (TMT)					Gas (MMSCM)				
	2022-23	2023-24		% Ach w.r.t		2022-23	2023-24		% Ach w.r.t	
	Actual	Target	Actual	Target	22-23	Actual	Target	Actual	Target	22-23
ONGC (N)	19493	19228	19210	99.9%	98.5%	19969	20559	19316	94.0%	96.7%
OIL (N)	3156	3371	3344	99.2%	106.0%	3041	3155	3090	97.9%	101.6%
PSC + RSC+CBM	6530	7404	6803	91.9%	104.2%	11440	14466	14032	97.0%	122.7%
Country	29179	30003	29357	97.8%	100.6%	34450	38181	36438	95.4%	105.8%

Figure 3.3: Oil Production of Country in 2023-24

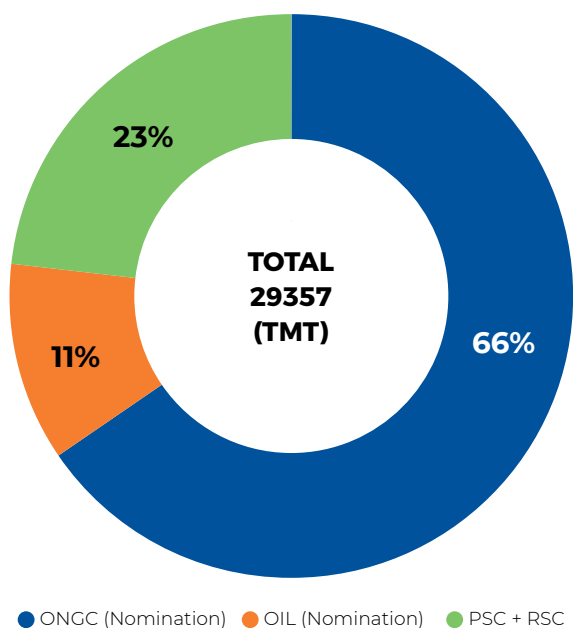


Figure 3.4: Gas Production of Country in 2023-24

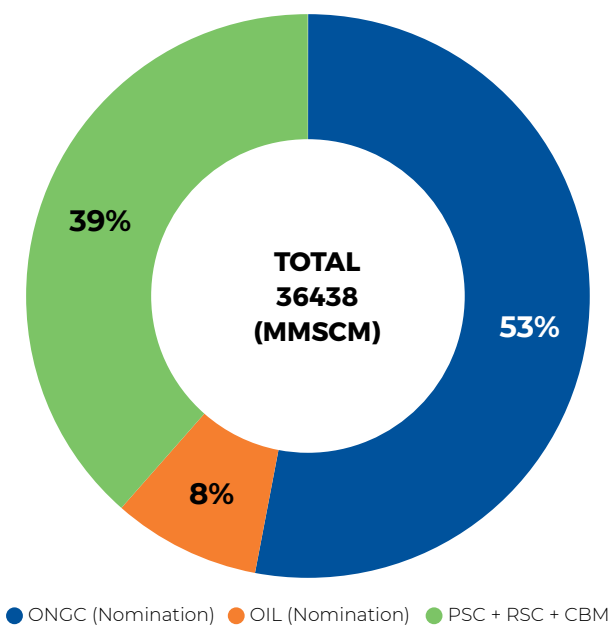


Table 3.5: Basin and Operator-wise production of country in FY 2023-24

Sl. No.	Operator	Basin	Oil (MMT)	Gas (BCM)	O+OEG (MMT)
National Oil Companies (NOCs) - Nomination					
1	OIL Nomination	Assam-Arakan Shelf	3.32	2.92	6.24
2		Rajasthan	0.03	0.17	0.20
Total (OIL Nomination)			3.35	3.09	6.43
1	ONGC Nomination	Assam-Arakan Fold Belt	0.002	1.525	1.527
2		Assam-Arakan Shelf	1.044	0.335	1.379
3		Cambay	4.530	0.787	5.317
4		Cauvery	0.226	0.988	1.214
5		Krishna Godavari	0.212	0.919	1.131
6		Mumbai	13.196	14.761	27.958
Total (ONGC Nomination)			19.210	19.316	38.526
Total NOCs			22.56	22.41	44.97
NOCs/PVT/JV Companies (PSC)					
1	CEIL	Cambay	0.330	0.200	0.53
2		Assam-Arakan Shelf	0.00002	0.006	0.00602
3		Krishna Godavari	0.480	0.112	0.592
4		Rajasthan	4.391	1.847	6.238
5	ESSAR	Cambay	0.00041	0	0.00041
6	FOCUS	Rajasthan	0.005	0.181	0.186
7	GEOENPRO	Assam-Arakan Shelf	0.020	0.005	0.025
8	GNRL	Cambay	0.006	0.009	0.015
9	GSPC	Cambay	0.029	0.007	0.036
10	HOEC	Assam-Arakan Shelf	0.016	0.207	0.223
11		Cambay	0.004	0.004	0.008
12		Cauvery	0.00005	0.006	0.00605
13		Mumbai	0.042	0.072	0.114
14	JTI	Cambay	0.029	0.010	0.039
15	KIRI	Cambay	0.0003	0.006	0.0063
16	NIPPON	Cambay	0.0004	0	0.0004



Sl. No.	Operator	Basin	Oil (MMT)	Gas (BCM)	O+OEG (MMT)
17	OILEX	Cambay	0.00042	0.001	0.00142
18	OILMAX	Assam-Arakan Shelf	0.011	0.057	0.068
19		Cambay	0.003	0	0.003
20	ONGC	Cambay	0.056	0.080	0.136
21		Cauvery	0.068	0.028	0.096
22		Krishna Godavari	0.184	0.582	0.766
23		Bengal	0	0	0
24	PAN INDIA	Cambay	0.001	0	0.001
25	RIL	Krishna Godavari	0.838	9.926	10.764
26	SELAN	Cambay	0.029	0.012	0.041
27	SACF	Cambay	0.00002	0	0.00002
28	SUNPETRO	Cambay	0.258	0.026	0.284
Total NOCs/PVT/JV COMPANIES (PSC)			6.80	13.38	20.19
Sl. No.	Operator	Block Name		Gas (BCM)	O+OEG (MMT)
COAL BED METHANE (CBM)					
1	ESSAR	Raniganj East		0.3151	0.3151
2	GEECL	Raniganj South		0.0958	0.0958
3	ONGC	Bokaro		0.0039	0.0039
4		Jharia		0.0015	0.0015
5	RIL	Sohagpur East		0.0004	0.0004
6		Sohagpur West		0.2338	0.2338
Total CBM				0.6505	0.6505
India Grand Total			29.36	36.44	65.80

*NOTE: Figures inclusive of condensate (MMT); 1MMT = 1 BCM

Overall there has been increase of ~0.6% in oil production and ~5.8% in gas production in Country. Rajasthan continued to dominate Onshore production with around 65% contribution to oil production under PSC regime. There is a significant increase in oil production of Eastern Offshore under PSC regime due to production commencement of

M-field of Block KG-DWN-98/2 in January 2024. Gas production from Krishna-Godavari saw a notable increase with the addition of new field (MJ) in PSC Block KG-DWN-98/3 in April 2023. Under Nomination regime, Mumbai offshore continues to contribute significantly to both oil and gas production of the Country.



Table 3.6: Contribution by ONGC, OIL and NOCs/Pvt./JVs in country's Oil and Gas production in last 10 years

Year	Oil Production (MMT)				Gas Production (BCM)				
	ONGC (Nomination)	OIL (Nomination)	PSC	Total Oil (MMT)	ONGC (Nomination)	OIL (Nomination)	PSC	CBM	Total Gas (BCM)
2010-11	24.42	3.59	9.68	37.69	23.09	2.35	26.73	0.04	52.22
2011-12	23.71	3.85	10.53	38.09	23.32	2.63	21.52	0.08	47.56
2012-13	22.56	3.66	11.64	37.86	23.55	2.64	14.38	0.11	40.68
2013-14	22.24	3.47	12.08	37.79	23.28	2.63	9.33	0.17	35.41
2014-15	22.26	3.41	11.78	37.45	22.02	2.72	8.68	0.23	33.65
2015-16	22.37	3.23	11.36	36.96	21.18	2.84	7.84	0.39	32.25
2016-17	22.21	3.26	10.53	36.00	22.09	2.94	6.31	0.56	31.90
2017-18	22.25	3.38	10.06	35.68	23.43	2.88	5.60	0.73	32.65
2018-19	21.04	3.29	9.87	34.20	24.67	2.73	4.77	0.71	32.88
2019-20	20.63	3.11	8.44	32.17	23.75	2.67	4.12	0.66	31.19
2020-21	20.18	2.94	7.37	30.49	21.87	2.48	3.68	0.64	28.67
2021-22	19.45	2.99	7.25	29.69	20.63	2.89	9.82	0.68	34.02
2022-23	19.49	3.16	6.53	29.18	19.97	3.04	10.77	0.67	34.45
2023-24	19.21	3.35	6.80	29.36	19.32	3.09	13.38	0.65	36.44

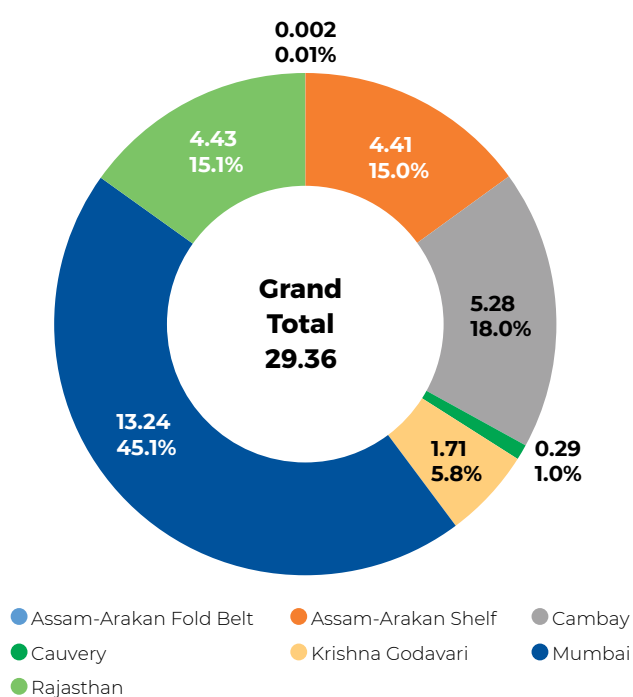
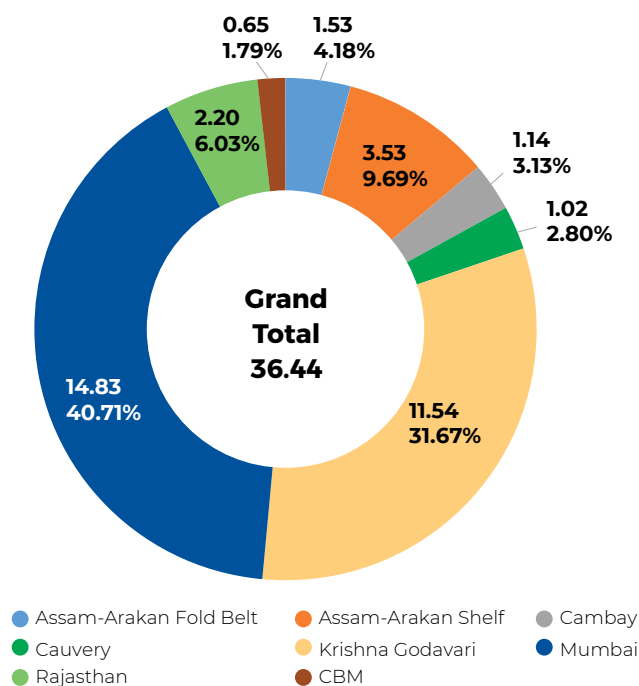
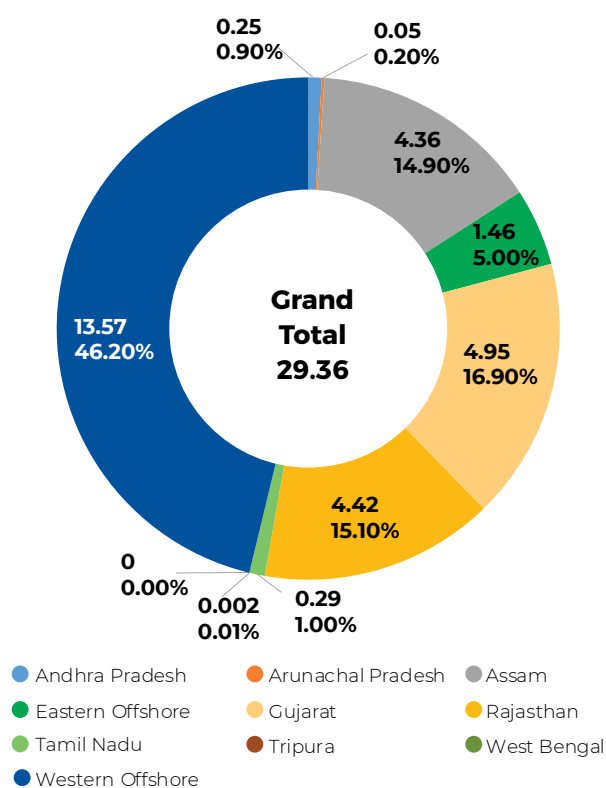
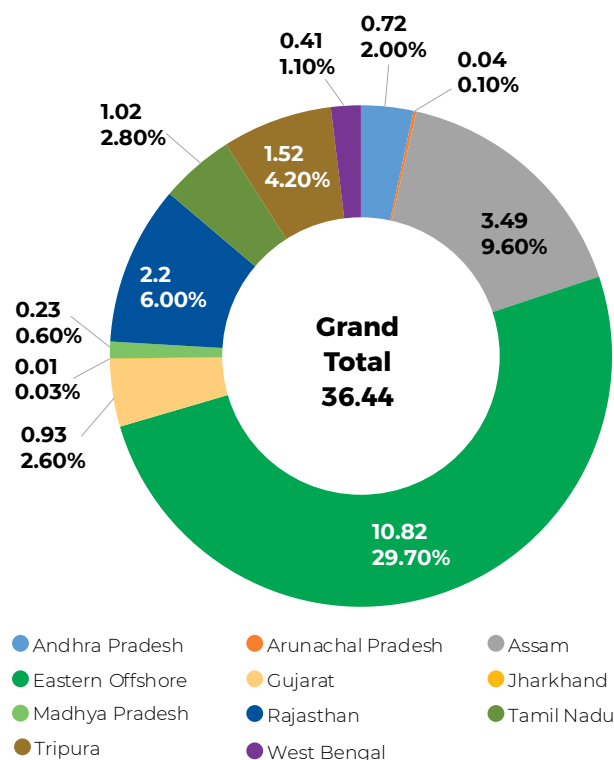
Figure 3.5: Country's Basin-Wise Oil Production in 2023-24 (MMT)**Figure 3.6: Country's Basin-Wise Gas Production in 2023-24 (BCM)**

Figure 3.7: Country's Location-Wise Oil Production in 2023-24 (MMT)**Figure 3.8: Country's Location-Wise Gas Production in 2023-24 (BCM)**

The Country's oil and gas production has risen consistently under PSC regime starting from year 1994-95 with gas production reaching a peak level during 2023-24 at level of 26.77 BCM and oil production reaching a peak of 12.08

MMT in 2013-14. With a renewed impetus to the sector through HELP and DSF bidding rounds and upcoming policies supporting enhance recovery from existing fields, the production figures are likely to hit peak again in near future.

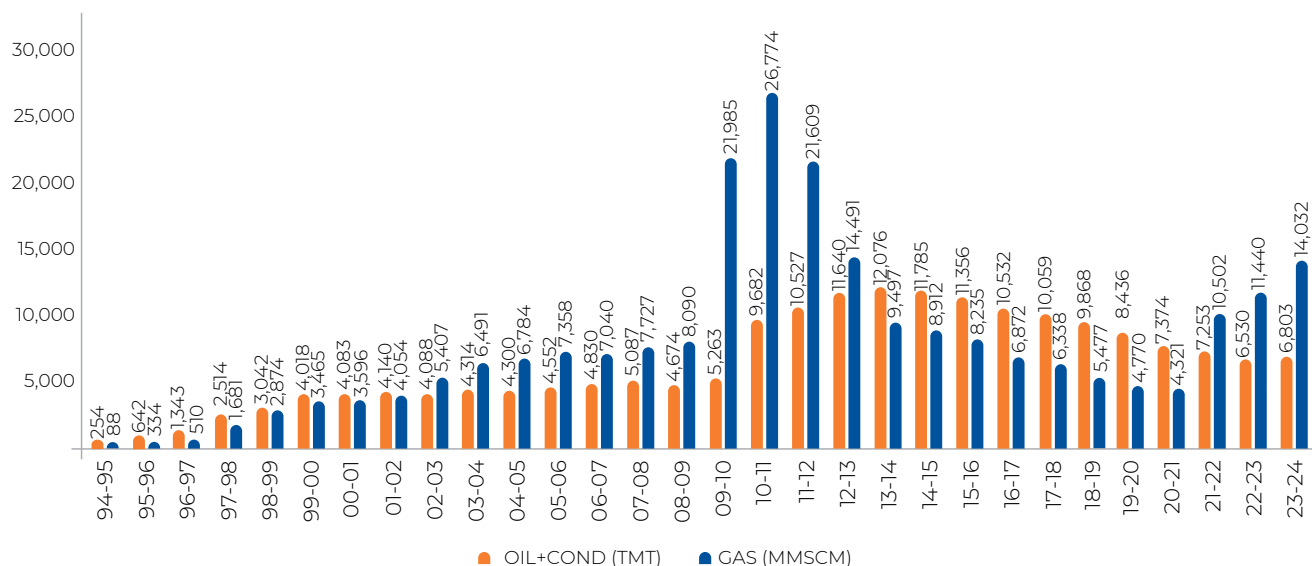
Figure 3.9: Oil and Gas Production in PSC + CBM Contract Regime Since Inception till 2023-24

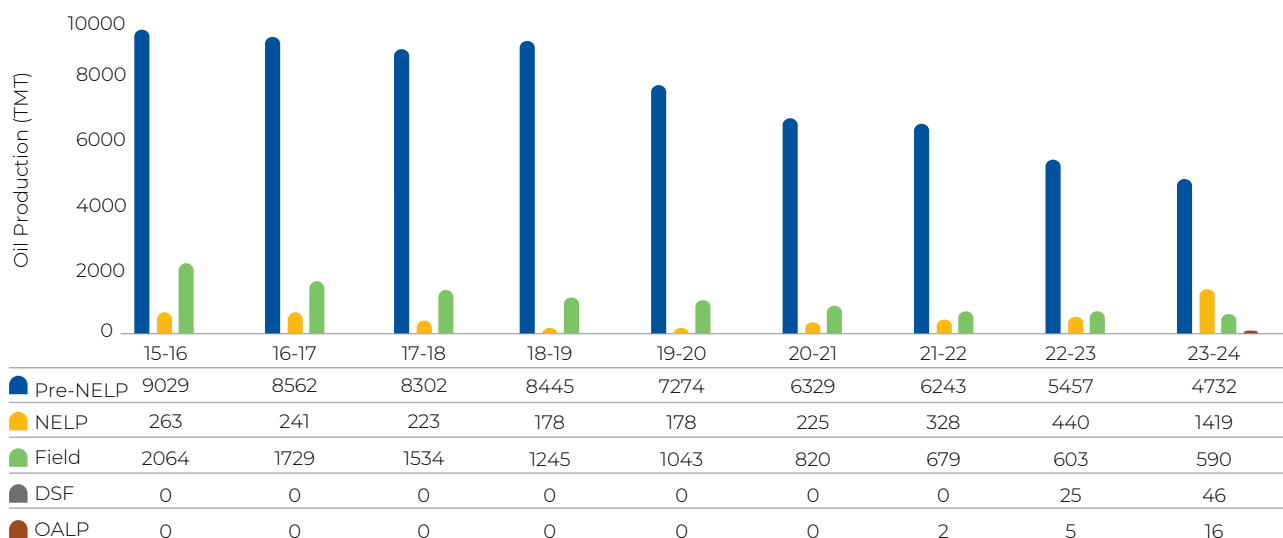
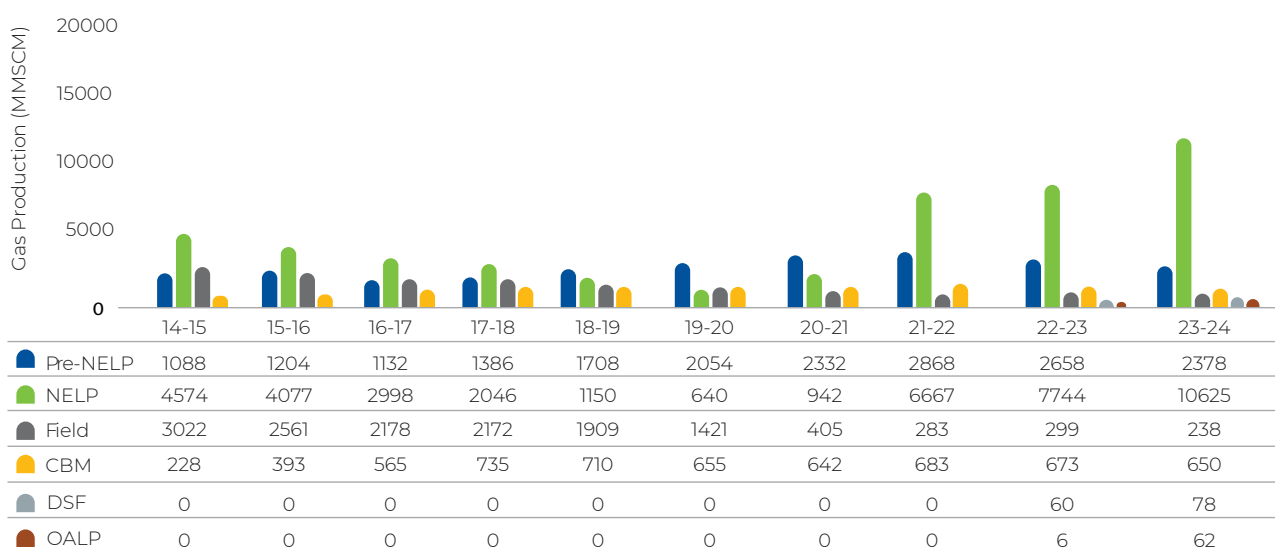
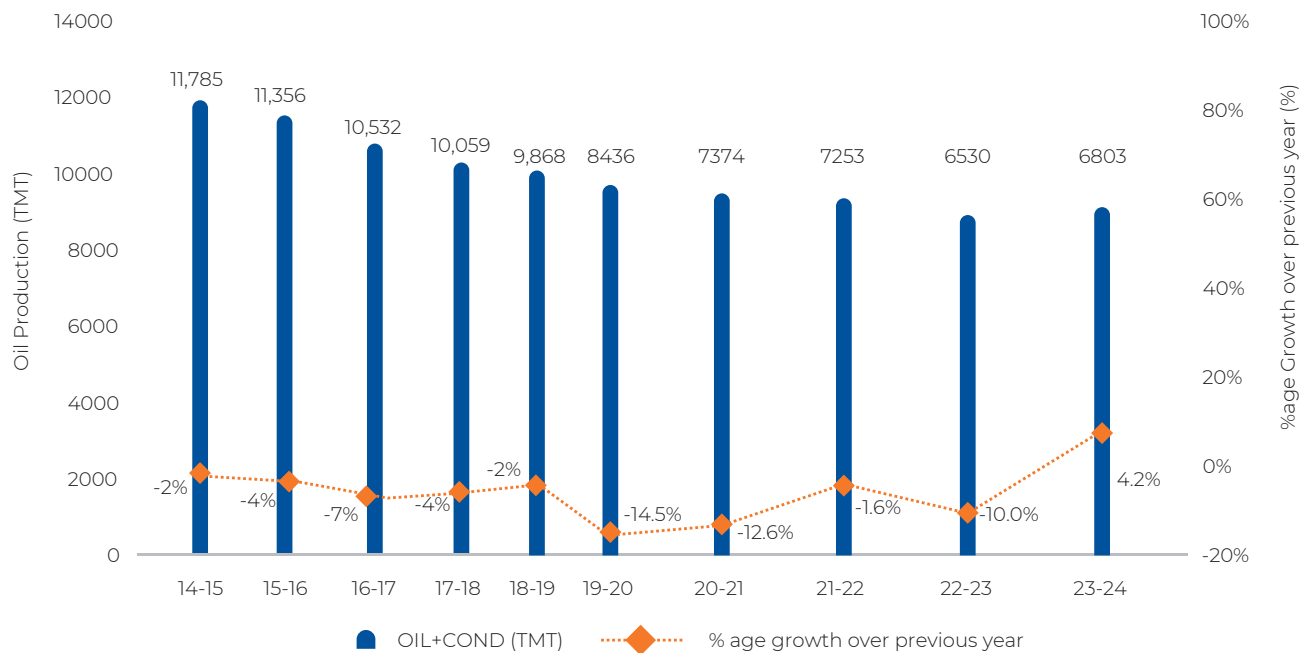
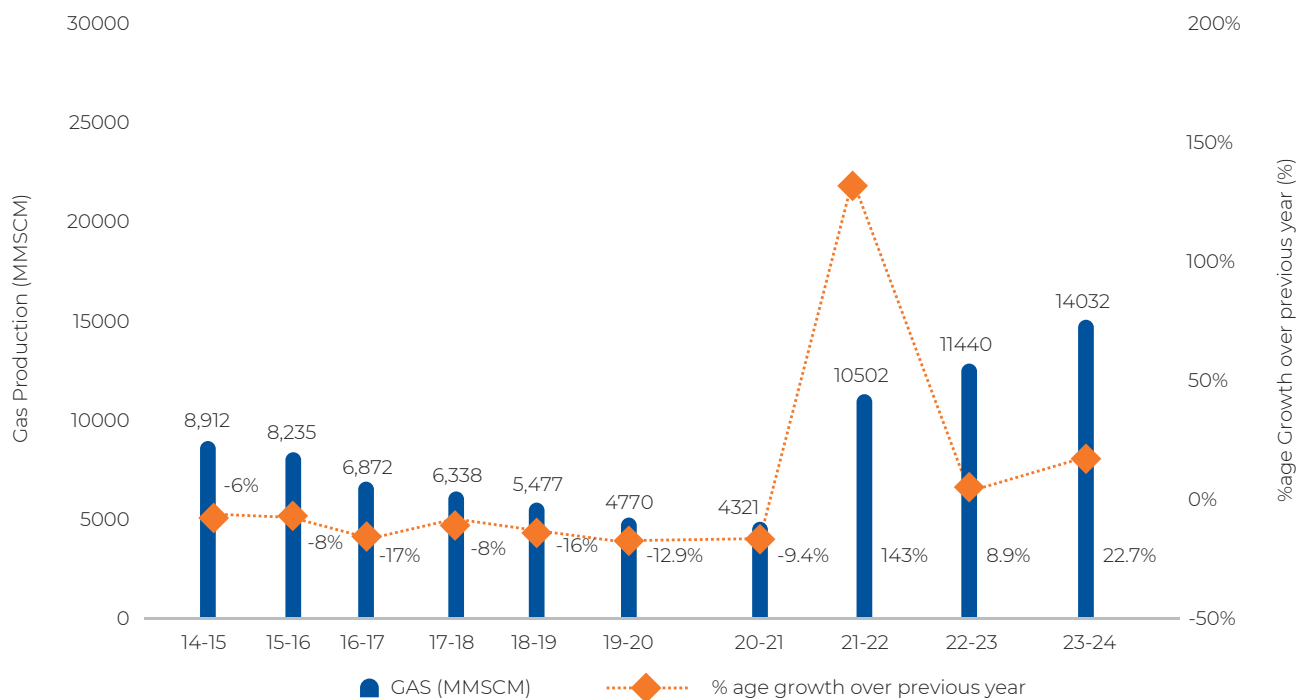
Figure 3.10: Crude oil production in PSC regimes in last 5 years (in TMT)**Figure 3.11: Natural Gas production in PSC regimes in last 5 years (in MMSCM)**

Figure 3.12: Trend in Oil Production in PSC & RSC Regime from 2014-15 to 2023-24**Figure 3.13: Trend in Gas Production in PSC, CBM & RSC Regime from 2014-15 to 2023-24**

4

Data Driven Strategies for Indian E&P



Oil and Gas Industry is one of the most data-rich industries and upstream data, that is, Exploration & Production (E&P) data is a significant part of it.

Historical Perspective

Oil and Gas Industry is one of the most data-rich industries and upstream data, that is, Exploration & Production (E&P) data is a significant part of it. Historical and new data have always been crucial to the success of any E&P venture. Throughout E&P lifecycle, huge amount of data is continuously generated during the planning, exploration, field development, and management phases. The industry has recognized the importance of leveraging data for making key business decisions from the early days of exploration.

India has a rich history of E&P activity dating back to the 19th century. Methodical E&P activity began after the first commercially successful well was discovered in Digboi, Assam, in 1889. The discovery of the first oil well in independent India was made by Assam Oil Company Limited (AOC) in Nahorkatiya in 1953, followed by Moran in 1956, both in upper Assam. AOC was later incorporated into



Oil India Private Limited in 1959, which became OIL as a PSU (in 1981) to increase the pace of exploration in Assam. In 1959, the Government set up Oil and Natural Gas Commission (ONGC), which intensified and spread exploration to various parts of the country. ONGC systematically started geophysical surveys in other sedimentary basins considered prospective, resulting in the discovery of the Ankleshwar oil field in Gujarat in 1960.

Offshore exploration in India was initiated with the experimental seismic survey in the Gulf of Cambay in 1962 and later in the western offshore. Detailed seismic surveys in the western offshore resulted in the discovery of a giant structure in Bombay Offshore in 1972-73, later termed as Bombay High Field. ONGC and OIL generated considerable amounts of E&P data through geoscientific surveys and drilling, making them the earliest dominant players in the Indian E&P industry. However, private sector E&P companies also contributed to data generation through the global bidding route under Pre-NELP (1980-95) and pre-NELP field rounds (1992-93) offers and discovered field rounds since the 1980s.

The real boost in exploration efforts and appraisal of Indian basins came during the NELP regime (1999-2015), particularly in

offshore areas, resulting in a quantum jump in data volume from the preceding era. Both NOC and private operators contributed to this using the latest technology of the time. Multi-client surveys, particularly, projects INDIASPACE 1 (2006) and INDIASPACE 2 (2009) were conducted under Non-Exclusive Multi-Client (NEMC) Policy which for the first time mapped west coast and east coast sedimentary basins of India on a regional/basinal scale. Lately, new data is being acquired by Operators in the blocks awarded in Open Acreage Licensing Program (OALP) and Discovered Small Field (DSF) rounds under Hydrocarbon Exploration and Licensing Policy (HELP) launched in 2016. A significant amount of seismic data has also been acquired under the government-funded schemes like onland National Seismic Programme (NSP)-2016-21, offshore Andaman Seismic Program (2020) and just concluded Exclusive Economic Zone (EEZ) Surveys (2023) with seismic 2D lines upto EEZ boundary in east and west coasts. Government is further continuing with funding "Mission Anveshan" in onshore and "Extended Continental Shelf (ECS)" in offshore to augment and infill the existing coverage of seismic data. Service providers have also been reprocessing vintage 2D/3D and CSEM data under the "value-addition" clause of NDR data policy to generate new insights from vintage data using their latest proprietary technology.



E&P data - A National Asset

E&P data is considered a valuable national asset, and its ownership lies with the government. The Petroleum and Natural Gas (Amendment) rules of 2006 mandate that all E&P operators in India provide to the Central Government or its designated agency with any data obtained as a result of petroleum operations in the country, free of cost. The E&P data policy issued by MoPNG in 2017 outlines the framework for data assimilation, disclosure, sharing, accessibility, and dissemination through the National Data Repository (NDR). The policy designates DGH as the agency for data submission.

Technological advancements in data processing, interpretation, and visualization provide opportunities to gain new insights into even age-old E&P data. The exponential growth in data volume and diversity of data types enables the processing of diverse data sets to identify relational patterns, which can improve understanding of the subsurface, design exploration campaigns, and optimize oil and gas production. Effective data management is crucial to develop a robust national E&P database and accelerating exploration and production activities in the country. Therefore, safeguarding E&P data is a matter of national significance.

National Data Repository

The National Data Repository (NDR) was established by the Government of India in 2014 under the Directorate General of Hydrocarbons (DGH) to assimilate, preserve, and disseminate a vast amount of data acquired by public and private companies, operators, agencies, and contractors during E&P activities over several decades. The data was previously scattered across different work centres of ONGC, OIL, and DGH, or held by the respective operating companies.

The main objective of the NDR is to organize and regulate the data for future exploration and development activities, as well as for research and development by educational institutions and government bodies. The NDR serves

as a national-level establishment capable of managing a massive volume of data and providing access to it for public use.

To implement the project, the government awarded a turnkey contract for the “Build, Populate and Operate” model for the NDR to M/s Halliburton Offshore Services in March 2014. After the initial set up and data loading, the NDR was officially launched for public use on 28th June 2017. The establishment of the NDR has facilitated the efficient management and utilization of E&P data and has helped to promote exploration and development activities in India's hydrocarbon sector.

The NDR is a key enabler of Open Acreage Licensing Policy (OALP) and Discovered Small Fields (DSF) rounds under the Hydrocarbon Exploration and Licensing Policy (HELP) regime. It provides E&P operators with the freedom to carve out blocks of their interest and size, facilitated by the E&P data provided by the NDR under the new policy regime.

In addition to its use in the oil and gas sector, the NDR's data are being utilized for research and development by educational/ academic institutions and government bodies. Overall, the NDR is a valuable resource for the Indian energy industry, offering a centralized repository of E&P data for reliable decision-making and future development.

Objectives of NDR

The broad objectives of NDR are as follows:

- To assimilate, validate, archive, preserve, reproduce, and disseminate data relating to prospecting, exploration, development, and production of hydrocarbons.
- To create and maintain a modern state of the art platform for reporting, managing, mapping and visualization using the latest technologies.
- To ensure that industry, academia, research bodies and other users have ready access to the E&P data in NDR for promoting E&P research



- To ensure transparent access to quality E&P data and promote conditions for innovation and investment in exploration and production to discover and drive development of new discoveries

Secondary Data Centre

DGH established its Secondary Data Centre (SDC) in high-tech Software Technology Parks of India (STPI), a Tier-III data centre at Bhubaneswar. SDC is located in a different seismic zone and geography than Primary Data Centre (PDC), NOIDA.

Data replication and synchronisation is maintained by 1 GBPS dedicated link between PDC and SDC. SDC works as a Business Continuity/Disaster Recovery Centre of Primary Data Centre (PDC) of National Data Repository of DGH, Noida. The Secondary Data Centre (SDC) is fully operational since 4th August 2018. SDC will be able to resume essential business operations in case of a disaster at PDC.

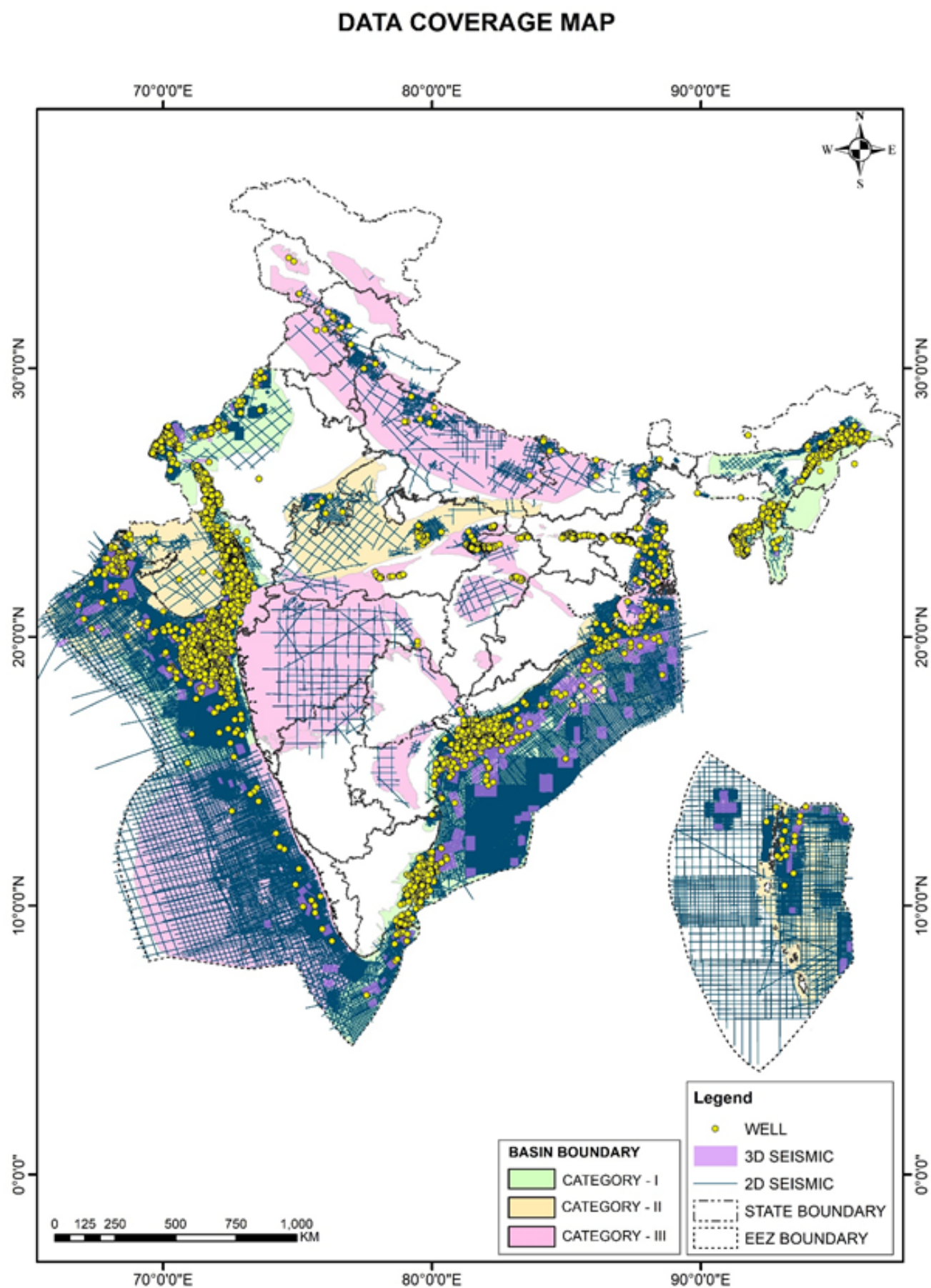
Apart from being data repository and recovery centre, SDC also provides quality industrial and educational trainings to the students of various academic institutions and organizations. These training programs are intended to give a domain-specific and industry-oriented approach for knowledge to the trainees. The course content of these training programs has rigorously been worked out by technical experts keeping in mind the syllabus of various institutions and its linkage to E&P industry.

Table 4.1: Data in NDR

Data available in NDR as of 31.03.2024	
2D Seismic data	3.6944 million LKM
3D Seismic data	1.1482 million SKM
Well data	23,616 wells
Well reports	49,704 reports



Figure 4.1: Map of India showing coverage of 2D/3D Seismic and well data in NDR



Role of NDR in OALP/DSF Bid Rounds

NDR is playing a pivotal role in the ongoing OALP & DSF rounds under HELP regime. It provides a gateway for operators/investors to carve out/select blocks/acreages of choice based on existing data, concessions, and no-go areas for putting up expression of interest/bids. NDR constantly updates its portal with the latest data, E&P related information, active license areas, restricted areas and other cultural features. NDR is providing easy access of quality data to the investors thus helping them make robust evaluation of blocks/acreage for investment decision. NDR is not only preparing data packages for blocks offered under every round but also facilitating interested E&P investors with visualization of G&G projects in the physical data room where they can understand and interpret available data within

offered blocks. In addition, NDR is also open to its users/academia for online browsing as well as evaluation/viewing of E&P data of any basinal area in its physical data room.

Important visits in NDR

The broad objectives of NDR are as follows:

- Visit of Hon'ble Minister of State, P&NG, Shri Rameshwar Teli on 10.10.2023
- Visit of Hon'ble Secretary, P&NG, Shri Pankaj Jain, IAS on 08.04.2023
- Visit of a team of IAS trainee officers on 18.09.2023
- Visit of Indian Naval Officers to understand the coastline geography and bathymetry



Visit of Hon'ble Minister of State, PNG, Shri Rameshwar Teli to NDR on 10th October 2023





Visit of Shri Pankaj Jain, Secretary, PNG to NDR Physical Data Room on 8th April 2023

Promoting exploration interests through Data visualisation room

In year 2023-24, NDR's physical data rooms were booked for total 62 days by 21 entities which include E&P operators, service providers, academic institutions and Govt organizations. In-house Seismic data Interpretation projects to be used in data visualization room were created in DSG software application for OALP-VIII, OALP-IX and Blocks under CBM bid rounds on offer by DGH. Apart from bid round specific projects several customised G&G interpretation projects of 2D, and 3D seismic data along with well data were prepared and made ready for visualization within a stipulated timeline after shorting-out all the quality control issues including data conditioning. Specific G&G projects were made incorporating 2D and 3D seismic data available in East coast sedimentary Basins of India, viz. Bengal, KG, Cauvery, and Andaman basin for showcasing data to various global E&P operators.

Data packages of 28 OALP-IX blocks were prepared for bid rounds so that prospective investors could order data specific to their areas of interest.

In total, 22 specific data packages were purchased by companies for doing their due diligence which excludes other bulk data purchases for general technical purpose.

Mini Data visualisation Centre at India Energy week (IEW) 2024

Based on the concept of physical data visualisation room of NDR at Noida, a mini data visualisation centre of was set up at DGH stalls of IEW at Goa, India. To facilitate this mini data centre, seven specific interpretation projects, were created in Decision Space Geoscience (DSG) software. Each project included 2D seismic data, well data, and selected 3D seismic volumes, providing stakeholders with a clear understanding of the availability and quality of data in their areas of interest.



The Mini Data Centre allowed participants to visualize and assess the data of blocks on offer through hands-on experience in a workstation environment. This initiative attracted significant attention from companies, investors, delegates, and academia during the conference.

The tailor-made projects offered insights into subsurface basin analysis through seismic and well data, motivated stakeholders to visit the physical data centre in Noida or directly acquire specific data from NDR. This, in turn, enabled them to perform detailed analyses and comprehensive due diligence for upcoming bidding rounds of OALP, CBM, and DSF.

Based on the concept of physical data visualization room of NDR at NOIDA, a Mini Data Visualization Centre was set up with a 55" LED screen. To facilitate this mini data centre, 28 interpretation projects were created, one each for 28 offered blocks under OALP Round IX. Additionally, one project was put up exclusively for Andaman basin to showcase salient features from latest seismic data. Each project included the 2D seismic data, well data and 3D seismic volumes. Projects were created using industry popular software like DSG and Petrel.



Mini Data visualisation Centre at India Energy week (IEW) 2024

The live data were up for displays and visitors from both national and global majors spent time on available datasets for basic understanding of the blocks. This showcase

segment was repeated in an extended format from what was hosted at the conferences like Geo INDIA 2022 at Jaipur, Rajasthan and India Energy Week 2023 at Bengaluru, Karnataka.



🔄 Data Dissemination in Year 2023-2024

Large volume of 2D/3D Seismic and well data and associated reports have been shared with stakeholders/operators since the inception of NDR. In FY2023-24, a total of 15,29,632 LKM 2D seismic, 6,65,882 SKM of 3D seismic and 3,522 well data have been disseminated to as many as 30 E&P companies and 10 research/ academic institutes. Through this, DGH has been able to generate a revenue of Rs. 47.22 Cr in FY2023-24 from data sale on promotional/nominal rates under the NDR Policy.

🔄 Archiving tape cartridges data to hard disc media

Operators routinely submit various E&P data, including raw and processed seismic data, well data etc., to NDR in Tape drives/cartridges. These data are received in various formats and generations of media such as Linear Tape Open (LTO), IBM 3590 and IBM 3592 etc. Although processed seismic stack data and well are read by the database applications in NDR and after due QC/validation such data, these are ingested in online servers of NDR; however, raw/field seismic data are only catalogued in database but remains on tapes/cartridges which are then kept in physical asset library of NDR.

Of late, the demand for raw data has increased considerably as more and more operators have become interested in reprocessing the vintage field data with latest proprietary technology to derive maximum information and imaging quality to drive their exploration/development programmes. Secondly, copying raw data from tapes/cartridges with limited number of tape

drives is very slow, sequential and inefficient affecting the data delivery to the users. Further, the media were getting older and, in some cases, started developing read error and thus needed to be refreshed. Thirdly, the process has been initiated to upgrade existing NDR to next generation cloud-based National Data Repository (NDR 2.0), wherein the entire E&P data including raw and processed seismic data are planned to be migrated to cloud-based storage system enabling very high fidelity/ durability in preservation, more efficient and wider dissemination of data.

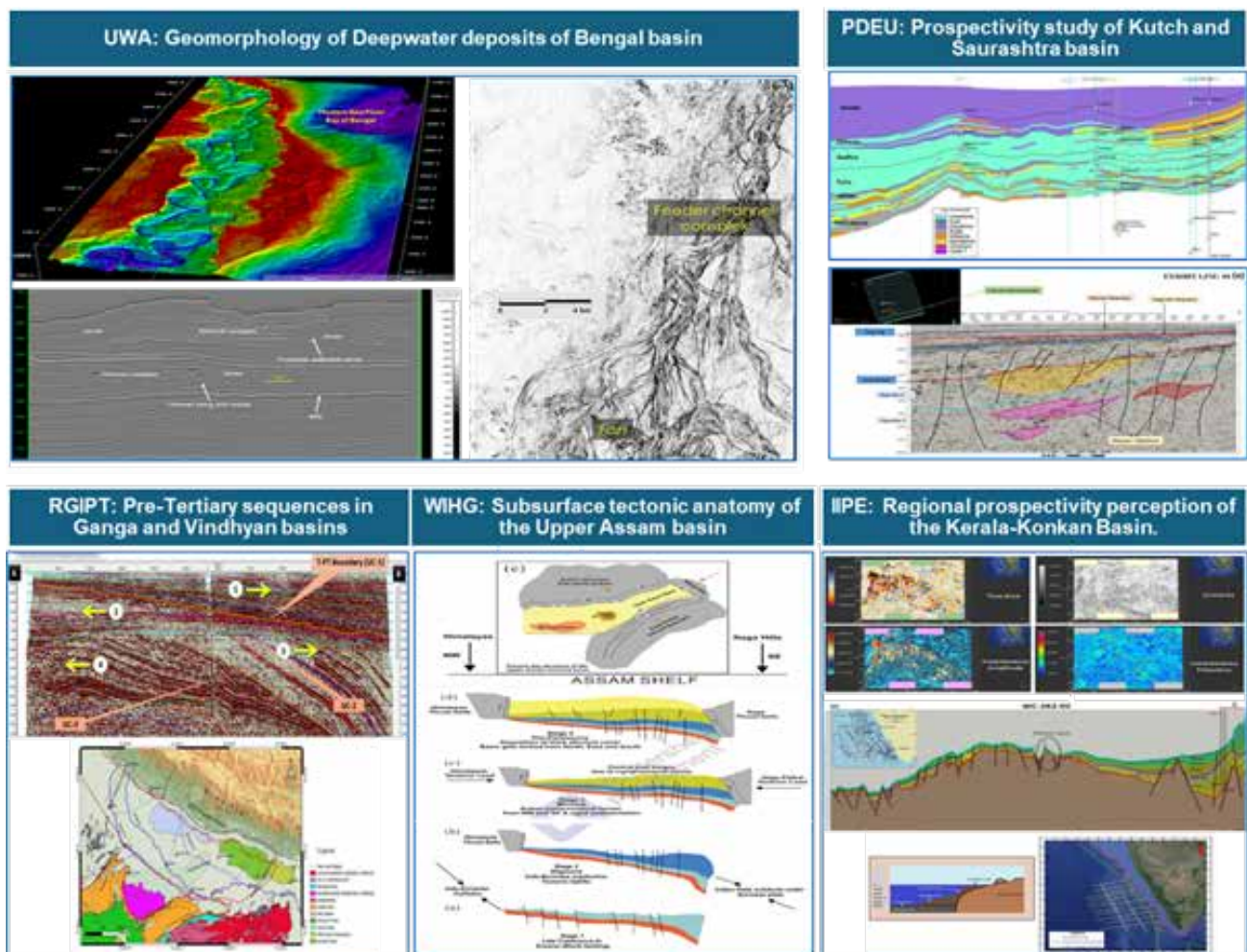
In view of the above and as a first step, NDR took up the task to archive raw seismic from the existing 3590/3592/LTO media/cartridges to external hard disks. These disks are meant to provide intermediate storage as well as a more convenient and faster media during the migration of raw data to envisaged cloud storage of NDR 2.0. In a contract awarded for tape archival, NDR archived 19,770 tapes/ cartridges to external hard disks aggregating a total size of ~4.5 Petabytes (PB). The job was started in Nov 2022 and completed in Feb 2024.

🔄 Technical collaboration with academia

During collaborative engagement with University of Western Australia (UWA), Pandit Deen Dayal Energy University (PDEU), Rajiv Gandhi Institute of Petroleum Technology (RGPT), Wadia Institute of Himalayan Geology (WIHG) and Indian Institute of Petroleum & Energy (IPE), various subsurface studies were undertaken to bring out seismo-geological insights as independent views to existing basin prospectivity analysis.



Figure 4.2: Glimpses of subsurface research works carried out by various academic institutions



Data rejuvenation, reprocessing and reorganization through Value-added model of NDR:

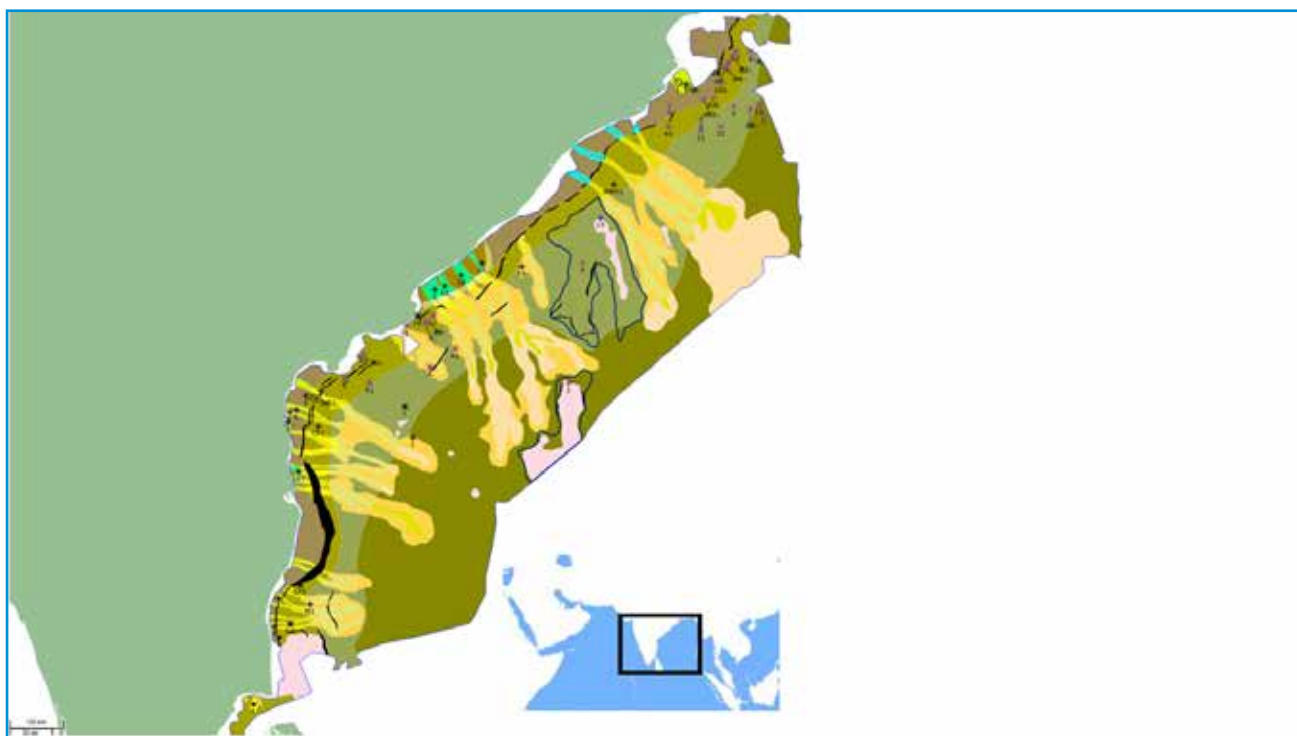
Under the provision of Article 3.7 of NDR Data Policy 2017, NDR shared well data of Cauvery, KG and Mahanadi Basins to M/s TGS to develop

- Stratigraphic model sedimentary fills and generate stratigraphic chart,
- Well-log-based 2nd and 3rd order sequences, chronostratigraphic and lithostratigraphic units, interpret lithology, environments of deposition (GDE) and associated depositional facies and
- Gross Depositional Environment (GDE) maps for key sequences within each basinal areas using previously value-added 2DCubed seismic data to extend the GDE interpreted at the well to create regional maps.

Accordingly, M/s TGS has completed above value addition project in the form of building Facies Map Browser and submitted the deliverables in January 2024. Advanced Reprocessing of legacy 3D seismic data by operators



Figure 4.3: Map Showing Regional GDE MAP covering Mahanadi, KG and Cauvery



Advanced Reprocessing of legacy 3D seismic data by operators

The legacy processing of vintage 3D data does not meet controlled amplitude and controlled phase (CACP) processing requirements in some of the potentially prospective offshore basins in the east coast, viz., KG and Cauvery basin. Other concerns in legacy product include low S/N in the near stack, residual multiple noise, and misalignment between the near and far stacks inhibiting reliable AVO analysis. Therefore, there is a significant value in reprocessing and merging vintage 3D data volumes with latest processing algorithms to achieve better imaging preserving amplitude and phases for more accurate AVO interpretation. In the below instance, an international operator carried out reprocessing/merging of three contiguous vintage 3D seismic surveys in the deep-water offshore area of Cauvery Basin with the objectives

- 1) To reduce velocity uncertainty through the construction of a high-quality anisotropic PSDM velocity model incorporating; well calibration, tomography & Full Waveform Inversion (FWI) to enhance complex imaging and address residual gather moveout.
- 2) To improve gather and stack quality through broadband processing.

The reprocessing resulted in significant improvement in imaging enabling quantitative amplitude interpretation over a much larger area for prospectivity evaluation.

The result clearly demonstrates the opportunity in reprocessing of vintage raw data for amplitude interpretation, de-risking of plays/prospect and improving the overall prospectivity of east coast basins.



Figure 4.4: [Top] Staked section of a legacy 3D volume in Cauvery Basin

[Bottom] Re-processed data of same section showing significant improvement of imaging

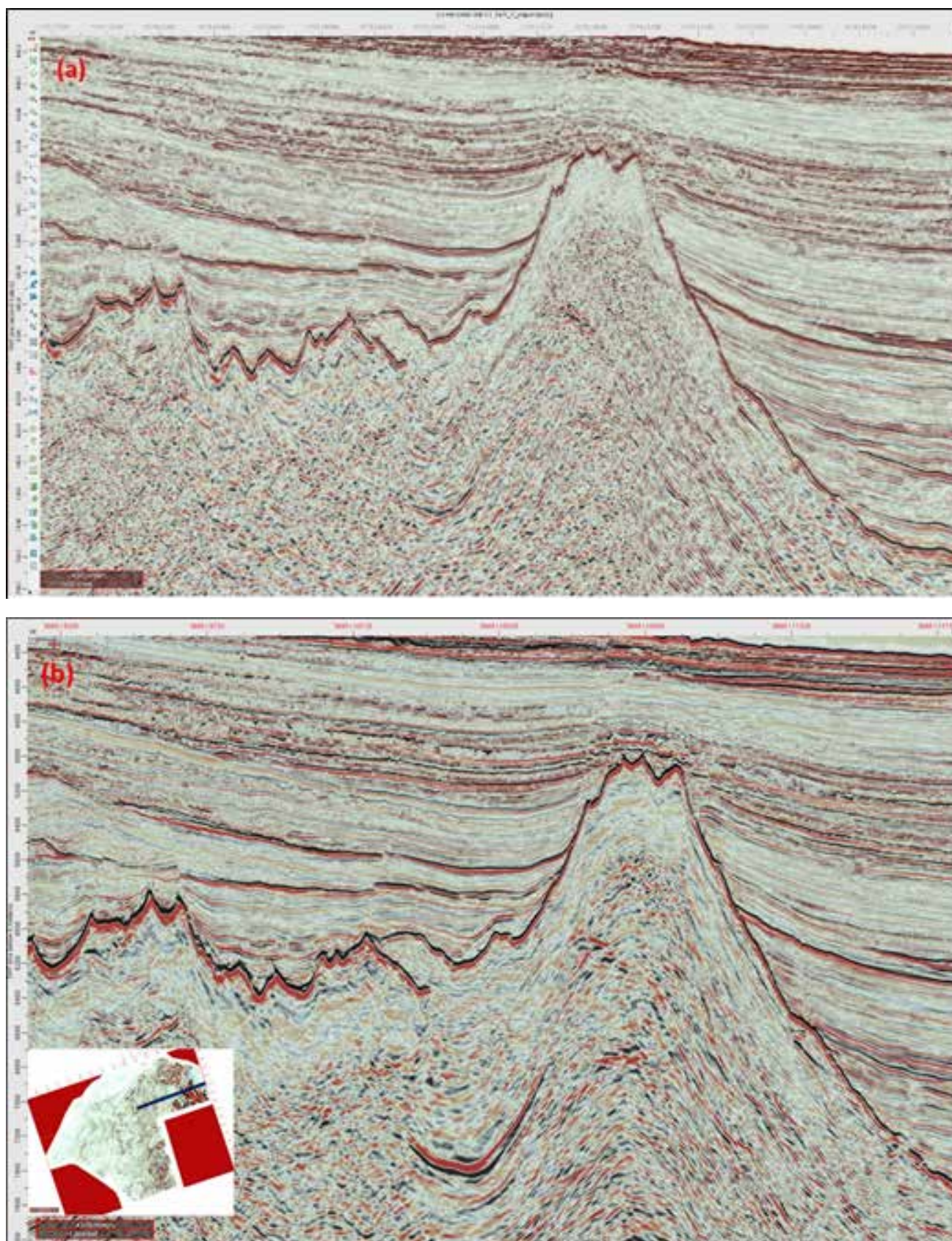
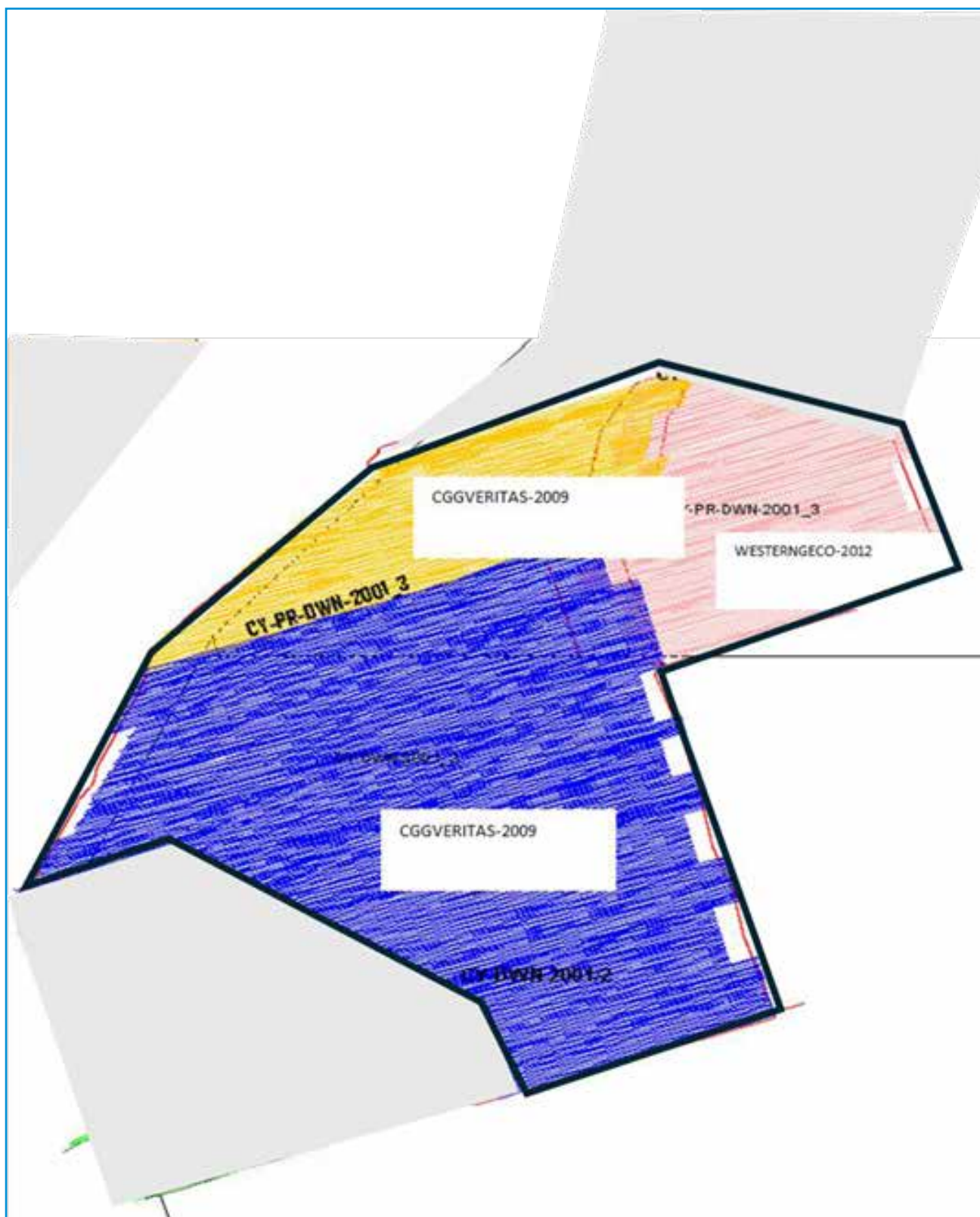


Figure 4.5: Areas/shapes of three separate 3D volumes of Cauvery basin used in merging and reprocessing



In-house sub-surface studies:

1) **Geo-Body and Geostatistical Modelling of Carbonate Reservoir Facies Architecture and Characterization:**

This study employs geo-body modelling to characterize reservoir variability and facies architecture in a field within the Mumbai High-Deep Continental Shelf of Mumbai Offshore Basin. By integrating geo-body extraction and geostatistical modelling, it effectively delineates facies architecture and reservoir heterogeneity. Results are published in the International Journal of Petroleum Technology.

2) **Analyzing Average Rig Time and Ease of Drilling in Indian Sedimentary Basins: An Informative Tool for Exploration Decision-Making:**

Using data from over 19,000 wells, this study provides insights into drilling durations and ease in Indian sedimentary basins. Calculating average rig time and total depth, and visualizing them as basin-wise maps, aids in estimating drilling costs and understanding structural variations. The ease of drilling metric offers valuable information for exploration project decision-making. Findings are published in the Journal of Geosciences Insights.

3) **Estimating Source Rock Parameters by Integrating Wireline Logs with Geochemical Data in Eocene Sediments of KG Basin, India**

This study was carried out to evaluate organic content of source rocks within Eocene sediments and assessing their potential for generating hydrocarbons using wireline log data. This study has revealed that average TOC of Eocene sediment is around 2.3%. TOC value is much higher in Godavari delta region compared to Krishna delta region. Study outcome was published in 14th international SPG conference held in Kochi on November 2023.

4) **Illumination of Subsurface Geological Elements using new seismic data in the East of Andaman basin with promising prospects for oil and gas exploration**

This study is conducted on newly acquired and processed seismic data from the East Coast of Andaman Basin. Various sedimentary units have been mapped to identify paleo-environments and trace the basin's evolution. It also revealed major fault developments and stratigraphic features, which are uniformly distributed during the tertiary and may serve as hydrocarbon entrapment zones. Study outcome was published at India Energy Week, 2024, Goa, India.

Promoting E&P research in Indian academic institute/university:

Under clause 5.3 of NDR Policy, students of recognised universities and research institutes are eligible to obtain data up to 50 Sq. km of area free of charge for E&P related research & development purpose. In this financial year, students of IIT Kharagpur, IIT Bombay, IIT Chennai and IIT ISM received data free of charge for research work.

National Data Repository 2.0

The NDR has been operational since June 2017, so far successfully meeting the demands of all of its stakeholders such as investors, operators, service-providers, R&D institutes, academia, and government bodies. However, with the rapid transformation of digital technology and the emergence of cloud technology, along with advancements in E&P data management, DGH has decided to upgrade it to Next Generation cloud based National data repository. Next generation National Data Repository 2.0 (NDR 2.0) aims to substantially improve the data accessibility (downloading), data reporting, submission (uploading) and enhance storage (for all E&P data types including seismic field data) and create a cloud-enabled database platform. To fulfil this objective DGH has engaged project management consultant,

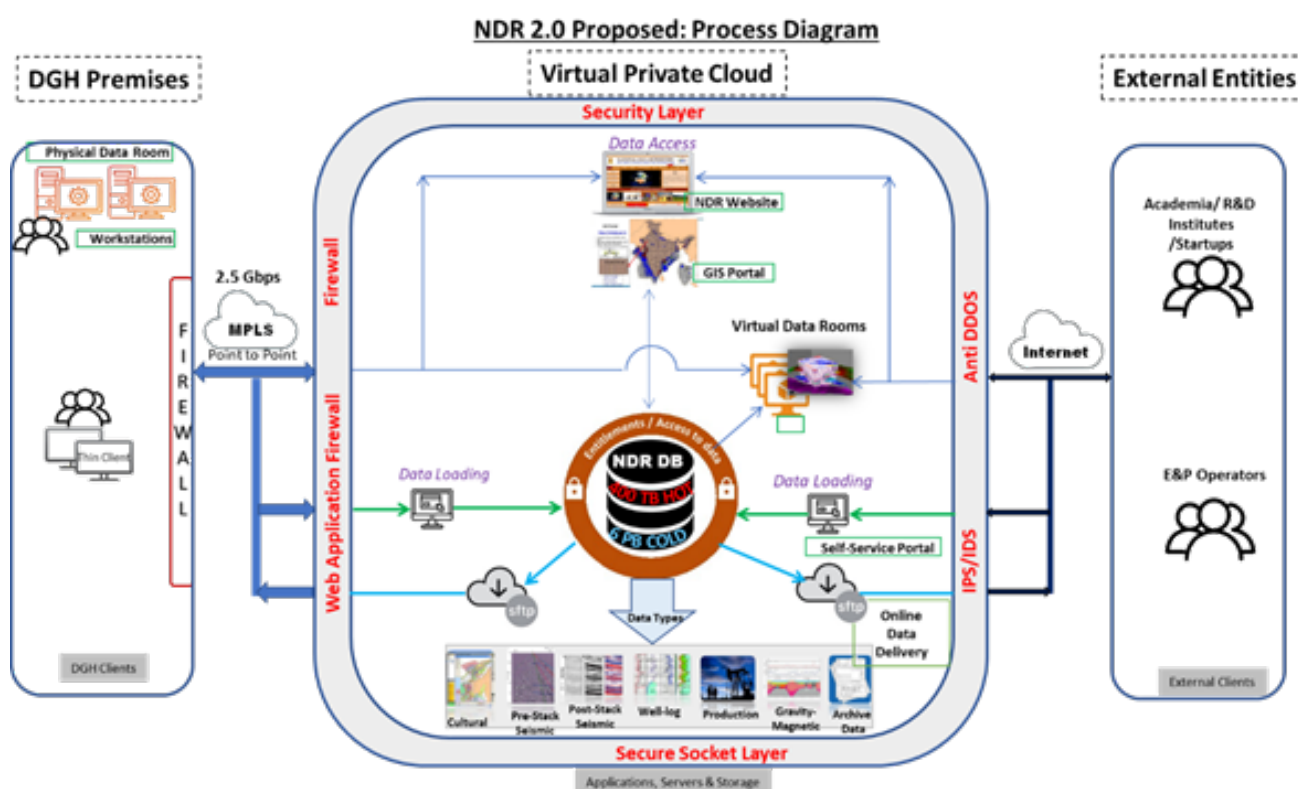


Digital India Corporation (DIC), a company under ministry of Electronics and Information Technology. DIC has led many govt. projects like DigiLocker, Diksha, etc. DGH and DIC team has jointly submitted detailed project report (DPR) to MoPNG. MoPNG has conveyed the approval. Tenders for NDR 2.0 have been floated on Government E-Marketplace (GeM) dated 23rd February, 2024.

Salient features of NDR 2.0:

- i. Cloud based Primary Data Centre (PDC) and Disaster Recovery (DR) solution on MEITY-empanelled IT Cloud.
- ii. Enhanced disk storage based sub-system to facilitate efficient raw and raw/Pre-Stack data management and delivery.
- iii. New look GIS-based portal with dashboard having extended search capabilities and enhanced user experience on data preview, data visualization and quick-look analysis with custom settings.
- iv. Secured Self-service data loading with automated data QC/ validation and downloading for entitled users, will reduce time for data submission and delivery through contactless process.
- v. Online data ordering, payment through web based online portal and online delivery of stack seismic data, well data and reports up to certain volume.
- vi. 24x7 Virtual Data Room - Online/ anywhere/anytime data visualization and interpretation facility.

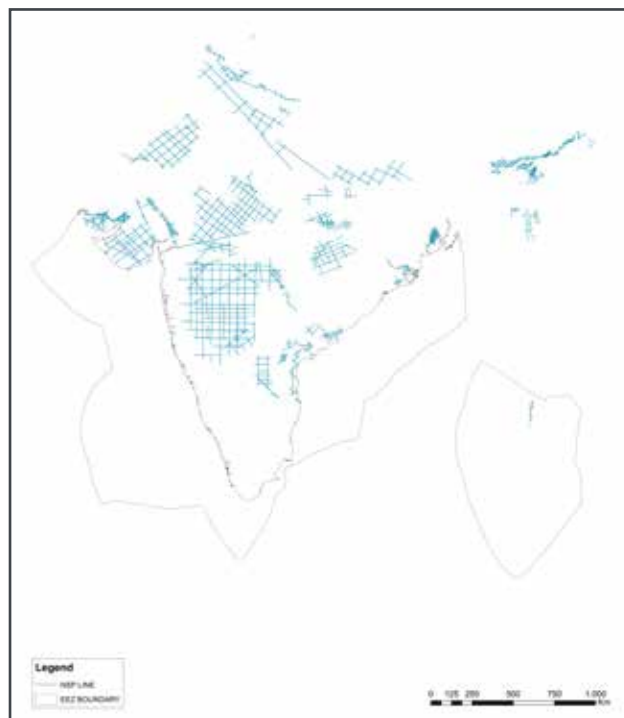
Figure 4.6: Process diagram of proposed NDR 2.0



DATA FOR COMPLETE APPRAISAL OF SEDIMENTARY BASINS

National Seismic Program (NSP):

Launched in October 2016, Government of India conducted 2D seismic survey in unappraised onland areas of Indian sedimentary basins. Under the programme, acquisition, processing, and interpretation (API) of 48,243 Line Kilo Metre (LKM) of 2D seismic survey was proposed. A total of 46,960 LKM (97% of the target) of 2D seismic data were acquired, processed and interpreted. The data acquisition programme was completed in February 2022. The processed seismic data along with reports were kept at National Data Repository (NDR). Gujarat Energy Research and Management Institute (GERMI), Gandhinagar, India conducted technical assurance study of the NSP data as the third party and such report was made available at NDR.

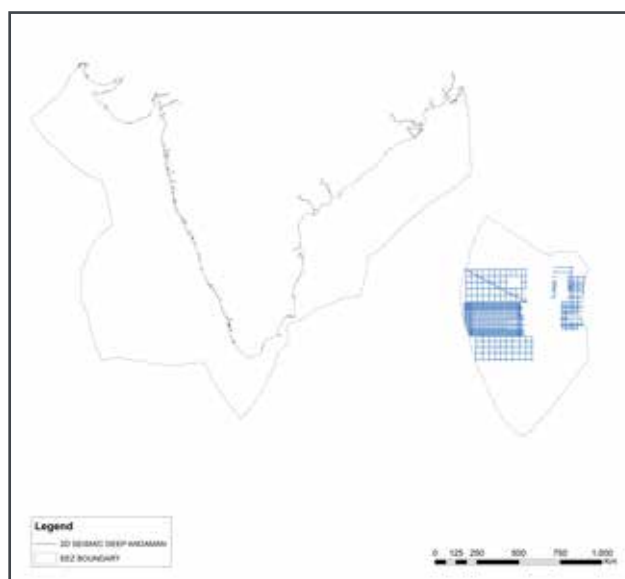


Andaman Seismic Survey:

Upon completion of seismic survey of onland basin areas under NSP, similar programme was planned in unappraised offshore area of Andaman Basin. The basin with 6,64,080 sq. km of India's Exclusive Economic Zone (EEZ) was hitherto appraised to the extent of 36% with 71,290 LKM of 2D seismic, 13,710 sq. km of 3D seismic data and 22 exploratory wells, mostly drilled in the easterly located forearc areas of the basin. The basin area surrounding the Andaman & Nicobar (A&N) islands had established the presence of hydrocarbons; however, exploration activities were then restricted as most of the area (~370,000 sq km) was designated as "No-Go" Zone.

Pursuant to inter-ministerial deliberations through Empowered Coordination Committee (ECC), DGH and the Department of Space (DoS) in coordination with the Island Development Authority (IDA) formulated a plan to carry out 22,500 LKM 2D seismic survey in unappraised areas of A

ndaman Basin as a part of data acquisition campaign for hydrocarbon exploration. Started in August 2021, acquisition of 22,564 LKM broadband seismic data in ultra-deepwater at a water depth 1,500-3,000m was completed in February 2022. Post processing and interpretation, data along with reports were made available at NDR in October 2022.



Airborne Gravity Gradiometry (AGG) Survey:

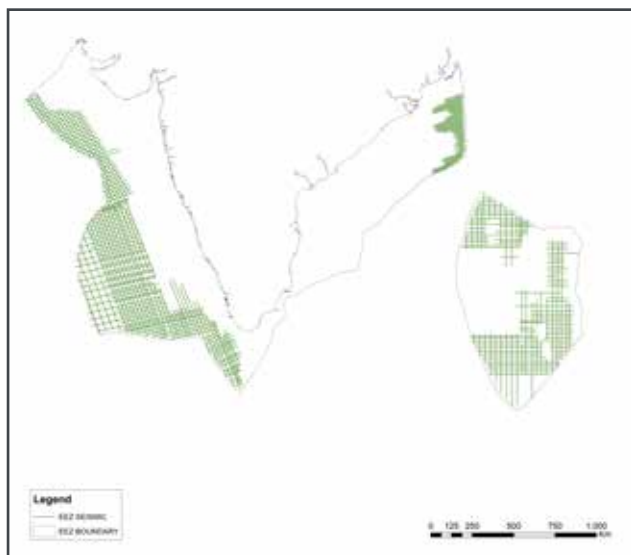
A quantum of 40,000 Flight LKM (FLKM) was planned to fill up the geographically inaccessible and hostile areas which could not be surveyed under NSP.

Started in May 2023, AGG Survey was completed in March 2024 with total data acquisition of 42,943 FLKM in areas of India's North Eastern Region of mostly Assam Arakan fold belt and part of Assam Shelf, including select traverse in areas of Cauvery, Bastar, Karewa and Spiti basins.

Post processing and interpretation, the data along with reports were kept at NDR.



Exclusive Economic Zones (EEZ) survey:



79, 540 LKM of 2D broadband seismic data acquisition programme was planned to fill up more than 1 million sq km of unappraised areas of offshore basins located within India's 2.36 million sq km of EEZ.

The survey was completed in three sectors namely West coast, East coast and Andaman offshore. Upon processing, the entire data set and reports were made available at NDR.

The data interpretation was in progress at the time of writing the report.

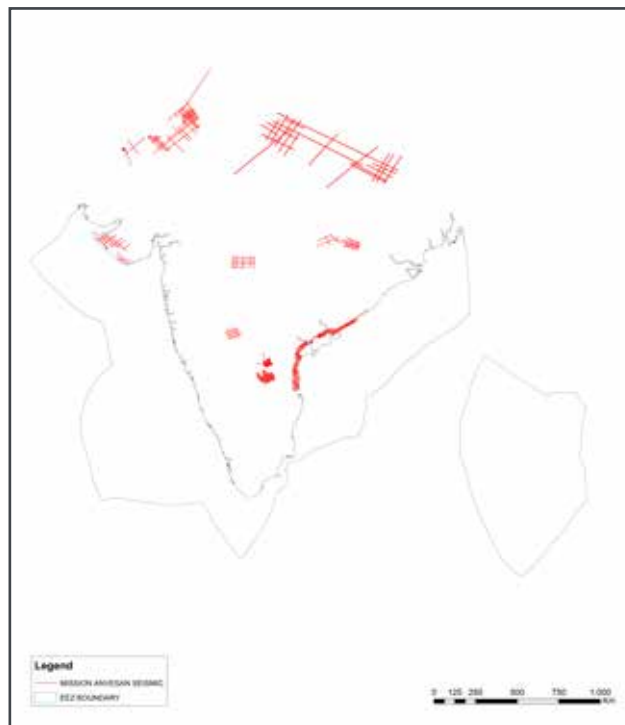


Mission Anveshan:

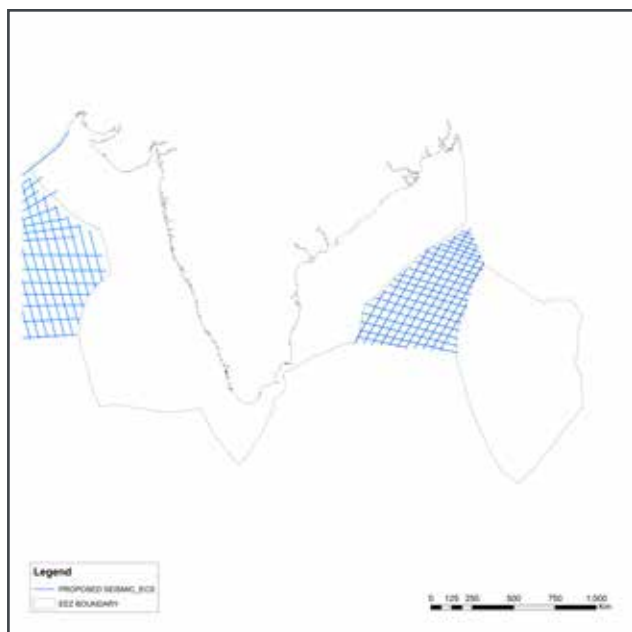
Based on the results of NSP data, there were areas identified with potential leads which called for detailed analysis and mapping with close grid data.

Under this programme titled Mission Anveshan, 20,275 LKM closed 2D seismic survey was planned in 7 onland sedimentary basins.

Approved in February 2024, the tendering of services was in progress at the time of writing the report.



Extended Continental Shelf Survey (ECS):



As a support of claim of extended continental shelf beyond EEZ by Ministry of Earth Sciences, both in eastern and western offshore, DGH had planned 30,000 LKM of close-spaced 2D seismic survey.

This would help enable acquisition of key subsurface data to establish shelf extension beyond EEZ.

The proposed survey was currently at the stage of tendering process for hiring suit able agency.

To enhance Sub-surface understanding, GoI has recently approved drilling of 4 stratigraphic wells in deepwater in Andaman, Mahanadi, Bengal and Saurashtra Basins.



5

Hydrocarbon Reserves & Resources



It is imperative to accelerate domestic production of hydrocarbon through two-pronged approach of Maximizing Production from producing fields and Enhancing Reserve Replacement Ratio (RRR) through accelerated exploration.



India is net importer of hydrocarbon to meet its ever-increasing domestic consumption. During FY 2023-24, It imported 232.5 MMT of crude oil which is about 89 % of its domestic consumption. Only 11 % of its requirement could be met through domestic oil production from NOCs and Private Companies. (Source: PPAC).

Therefore, it is imperative to maximize domestic production through optimized exploitation of **reserves** by way of improved and enhanced recovery, in addition to revival of non-flowing wells in time bound manner. Similarly, **contingent resources** that are locked up in discoveries and fields should be upgraded through expeditious address of contingency by adopting alternate development strategies. As India is reckoned with substantial undiscovered or yet-to-find (YTF) in-place that are risked out to **significant prospective resources** (13 billion ton oil-equivalent), exploration should be aggressive and targeted for established, known and new plays for striking potential discoveries.

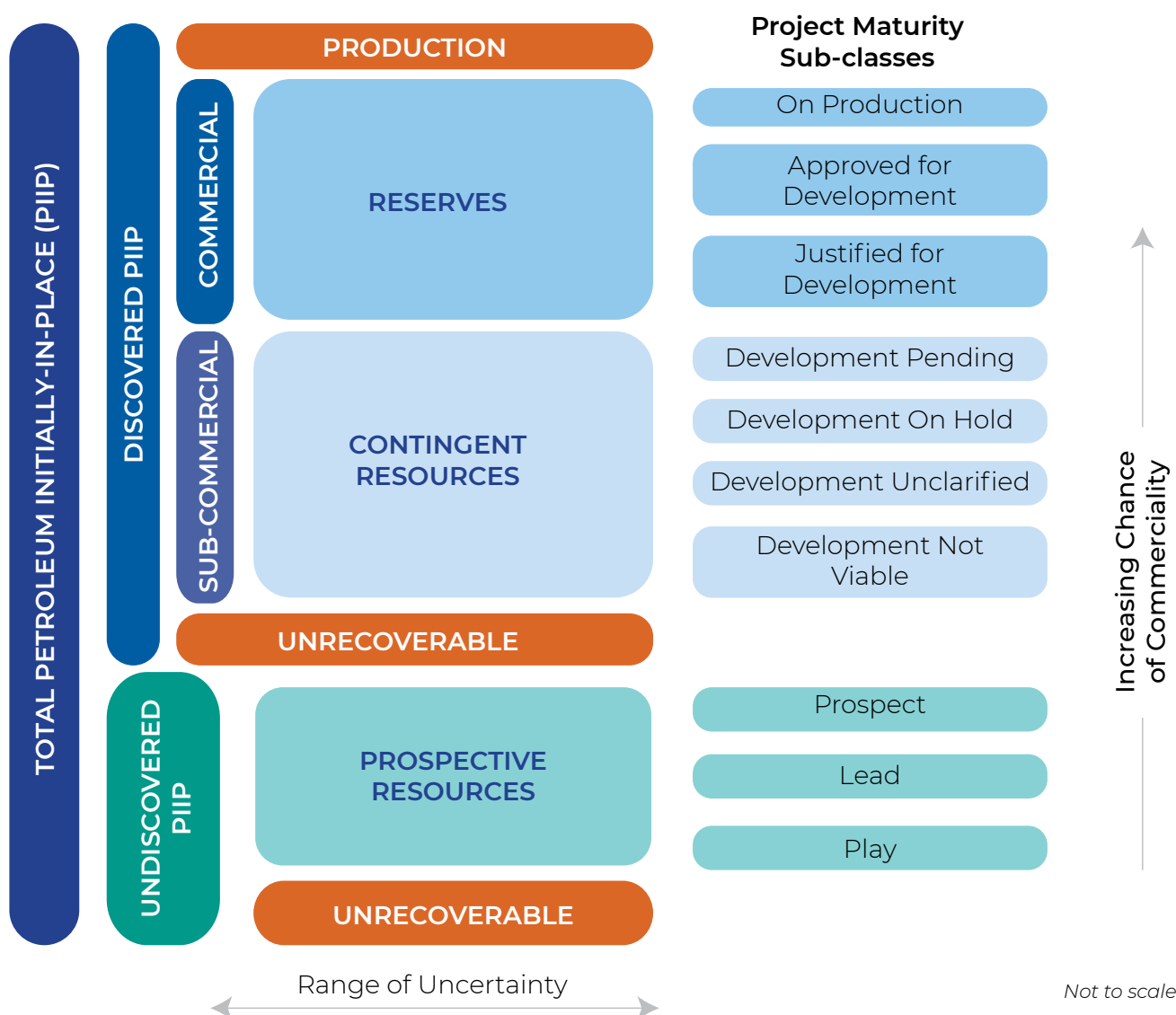


🔄 DGH initiatives in introduction of PRMS:

DGH initiated a periodical update of country-level database on **Reserves and Resources** of oil and gas as per **Petroleum Resources Management System (PRMS)** standard

for all blocks and fields across all operating regimes both Nomination and Contract. Effective 01.04.2021, all Indian E&P operators were directed to adopt and adhere the PRMS standard in reporting the company-level resource and reserve portfolio.

Figure 5.1: Sub-classes based on project maturity



PRMS is an internationally standardized system for hydrocarbon accounting developed for consistent and reliable definition, classification, and estimation of hydrocarbon resources. The Society of Petroleum Engineers (SPE) Oil and Gas Reserves Committee (OGRC) completed the revision of the PRMS and the SPE Board approved it in June 2018. The updated PRMS was approved by six sponsoring societies,

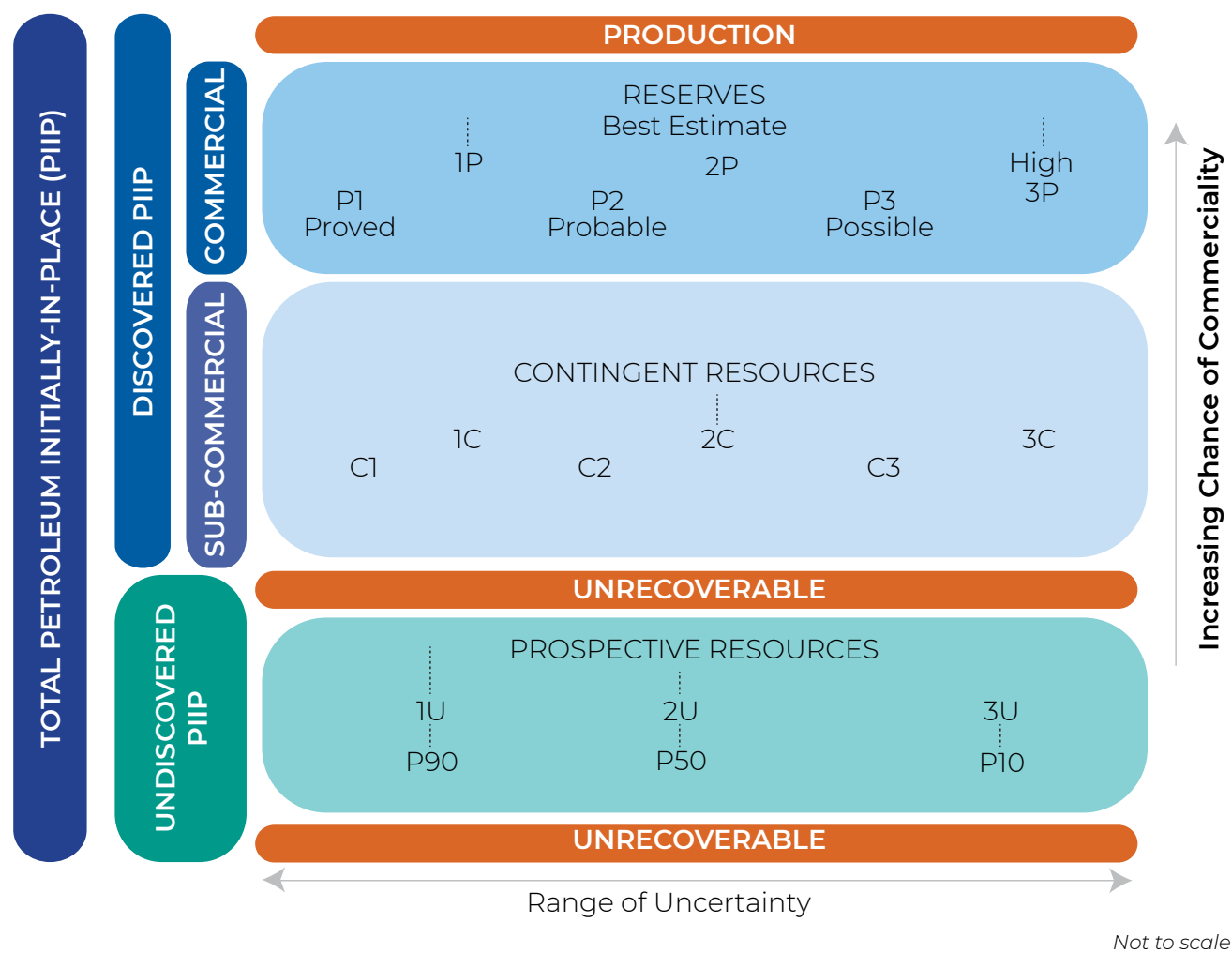
namely the World Petroleum Council (WPC), the American Association of Petroleum Geologists (AAPG), the Society of Petroleum Evaluation Engineers(SPEE), the Society of Exploration Geophysicists(SEG), the European Association of Geoscientists and Engineers(EAGE), and the Society of Petrophysicists and Well Log Analysts(SPWLA).



E&P Operators in the country were directed to undertake estimation, classification, categorization, auditing and reporting of all hydrocarbons reserves and resources in accordance with PRMS standard and furnish reports along with supporting data to DGH as of 1st of April of new Financial Year (FY).

It is worth mentioning that all technical submissions to DGH such as Declaration of Commerciality (DOC), Field Development Plan (FDP) and Revised FDP should be accompanied by the statement of resources and reserves based on project status and chance of commerciality conforming to the PRMS standards.

Figure 5.2: Resources classification framework



As seen in the accompanying classifications, DGH maintains data pertaining to discovered petroleum initially in-place (PIIP) under three categories as Production (Cumulative), Commercial PIIP with its corresponding Reserves and Sub-commercial PIIP with its corresponding Contingent Resources.

🌐 **Country's Reserves and Resources- Facts & figures**

As of 01-April-2024, Operators have reported about 671 MMT and 1094 BCM of recoverable (2P+2C) oil and gas respectively at the country level. There are five E&P operating regimes in the country, namely Nomination, Production



Sharing Contract (PSC), Open Acreage Licensing Program (OALP), Discovered Small Fields (DSF), and Coal Bed Methane (CBM) where both conventional and unconventional hydrocarbon resources are developed and produced.

Nomination regime fields operated by two National Oil Companies (NOC), Oil & Natural Gas Corporation Ltd. (ONGC) and Oil India Limited (OIL) have major share of 70% and 61% in total recoverable (2P+2C) oil and gas volumes respectively.

The total 2P reserves at country level for oil and gas are **434 MMT and 643 BCM** and the fields under Nomination regime have a significant share of **83% and 58%** of total reserves of oil and gas respectively.

The total 2C contingent resources at country level are **237 MMT and 451 BCM** and the fields under Nomination regime have a major share of **47% and 64%** of total oil and gas respectively. Nomination acreage have also significant shares in fields and blocks under PSC and other operating regimes.

Unconventional CBM regime accounts for 9% share in India's 2P gas reserves.

It is worth mentioning here that the 2P reserves reported by NOCs for fields under nomination regimes is based on field's economic life whereas for PSC, DSF and OALP regimes, 2P reserves are till the expiry of PSC or RSC contracts. The 2P EUR of Nomination fields for

oil & condensate is 27 % of its in place at the end of field's life with recovery factor of 22 % as on 1st April 2024. It provides immense opportunity to NOCs to review major oil fields under Nomination Regimes and develop a strategy to accelerate production by undertaking infill drilling, campaign to improve water injection performance with continuous monitoring of water injection wells/plants. DGH will be happy to be a part of this mission of maximizing production from nomination regime fields

The reported contingent resources (2C) in the country are significantly high and need to be prioritized by addressing associated 'contingencies' holding back their upgrade to reserves. New or re-development projects should be focused with a defined timeframe. Existing and new projects of Enhanced Oil Recovery (EOR methods), which have already been modelled and are technically matured after the successful pilot phase, need to be commercially implemented at the field scale to upgrade the contingent resources to reserves.

DGH, as the central body for managing petroleum reserves and resources at the country level is constantly interacting with all E&P Operators for maximizing the reserves at a field level by adopting the best global practices in reservoir management.

In the following references EUR is used to represent commercial recoverable PIIP, i.e. the sum of cumulative production and reserves.

Table 5.1: India's Hydrocarbon Reserves status as of 01.04.2024 (provisional)

Regime	2P In-Place		2P EUR		Accretion during 2023-2024		Reserves (2P)		Contingent Resources(2C)	
	Oil+Cond. (MMT)	Gas (BCM)	Oil+Cond. (MMT)	Gas (BCM)	Oil+Cond. (MMT)	Gas (BCM)	Oil+Cond. (MMT)	Gas (BCM)	Oil+Cond. (MMT)	Gas (BCM)
Nomination (ONGC & OIL)	6209.4	2761.8	1697.6	1421.0	9.3	10.7	361.9	374.8	110.2	289.4
PSC	956.1	770.8	229.9	346.9	3.8	19.8	67.1	187.4	121.1	106.7
DSF	63.8	91.6	5.4	24.5	1.2	6.3	5.3	24.1	5.0	19.1
OALP	6.2	34.1	0.0	0.0	0.0	0.0	0.0	0.0	0.9	20.1
CBM	0.00	342.7	0.0	63.7	0.0	-1.2	0.0	57.2	0.0	15.4
Grand Total	7235.4	4001.1	1933.0	1856.1	14.2	35.6	434.3	643.4	237.1	450.8

Note: As per data received from NOCs and Private/JV Companies; (-ve) accretion denotes revision in reserves/resources after adoption of PRMS standard.



Figure 5.3: Regime-wise Petroleum In-place, EUR, 2P Reserves, 2C Resources (Oil + Condensate, in MMT) as of 01.04.2024

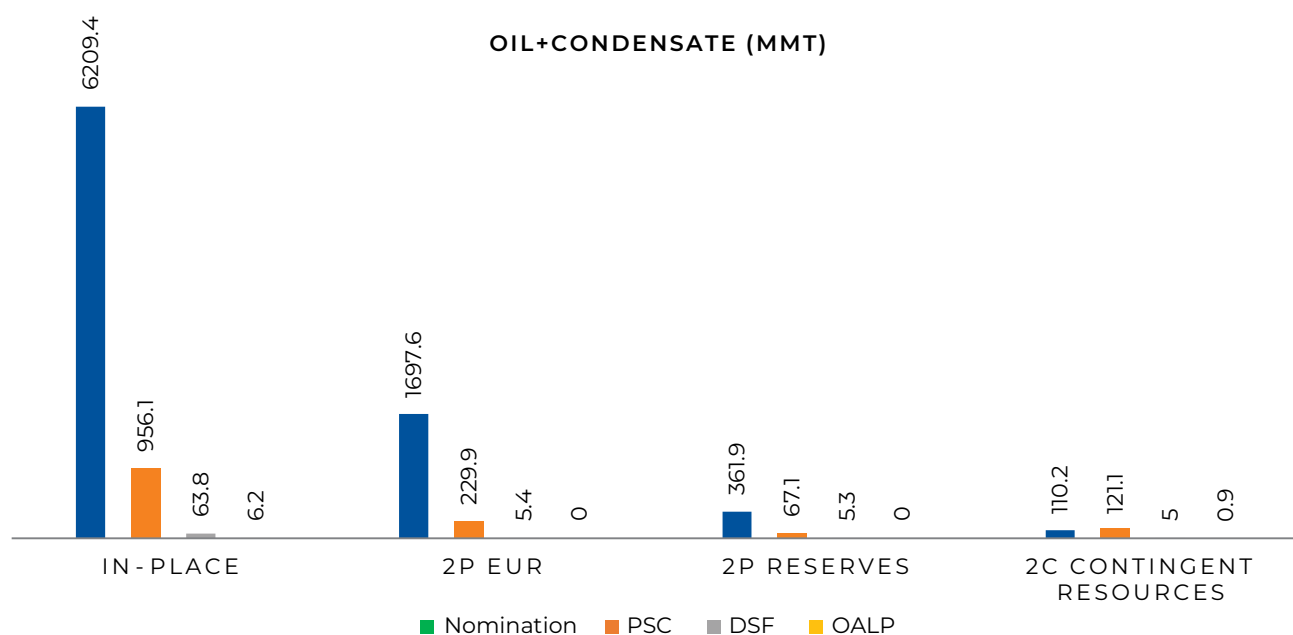


Figure 5.4: Regime-wise, Petroleum In-place, EUR, 2P Reserves, 2C Resources (Gas, in BCM) as of 01.04.2024

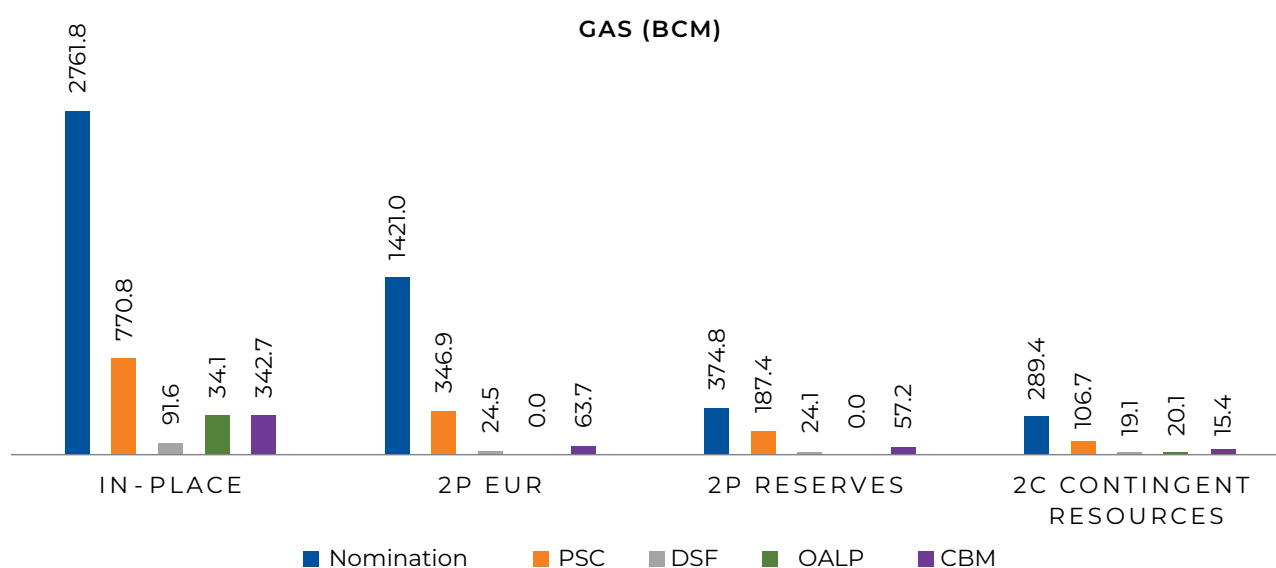


Table 5.2: Oil and Condensate (MMT) In-place-Reserves-Resources across Location/State as of 01.04.2024

Location/State	In-Place	2P EUR	2P Reserves	2C Contingent Resources
ONLAND	3617.8	911.8	231.6	185.9
ARUNACHAL PRADESH	44.8	5.2	2.3	0.6
ASSAM	1346.5	375.8	104.1	41.3
GUJARAT	1504.3	380.5	92.6	26.3
MADHYA PRADESH	0.0	0.0	0.0	0.0
RAJASTHAN	532.5	122.0	23.4	108.1
WEST BENGAL	1.0	0.02	0.02	0.1
MIZORAM	0.0	0.00	0.0	0.0
NAGALAND	12.5	1.0	0.0	2.4
TRIPURA	0.0	0.1	0.1	0.0
TAMILNADU	102.9	17.1	5.8	2.7
ANDHRA PRADESH	73.2	9.9	3.3	4.4
JHARKHAND	0.0	0.0	0.0	0.0
OFFSHORE	3617.7	1021.2	202.7	51.2
EASTERN OFFSHORE	269.3	82.8	32.2	8.4
WESTERN OFFSHORE	3348.3	938.4	170.5	42.8
Grand Total	7235.4	1933.0	434.3	237.1

Note: As per data received from NOCs and Private/JV Companies

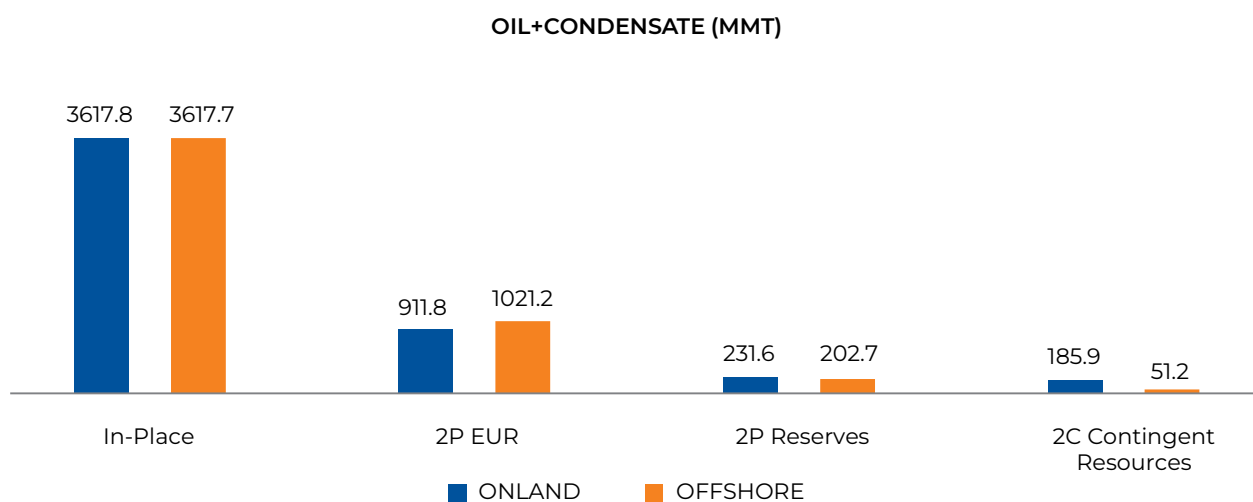
Figure 5.5: Location-wise Oil and Condensate (MMT) In-place-Reserves-Resources as of 01.04.2024

Figure 5.6: State-wise Onland Oil and Condensate (MMT) 2P Reserves + 2P Resources as of 01.04.2024

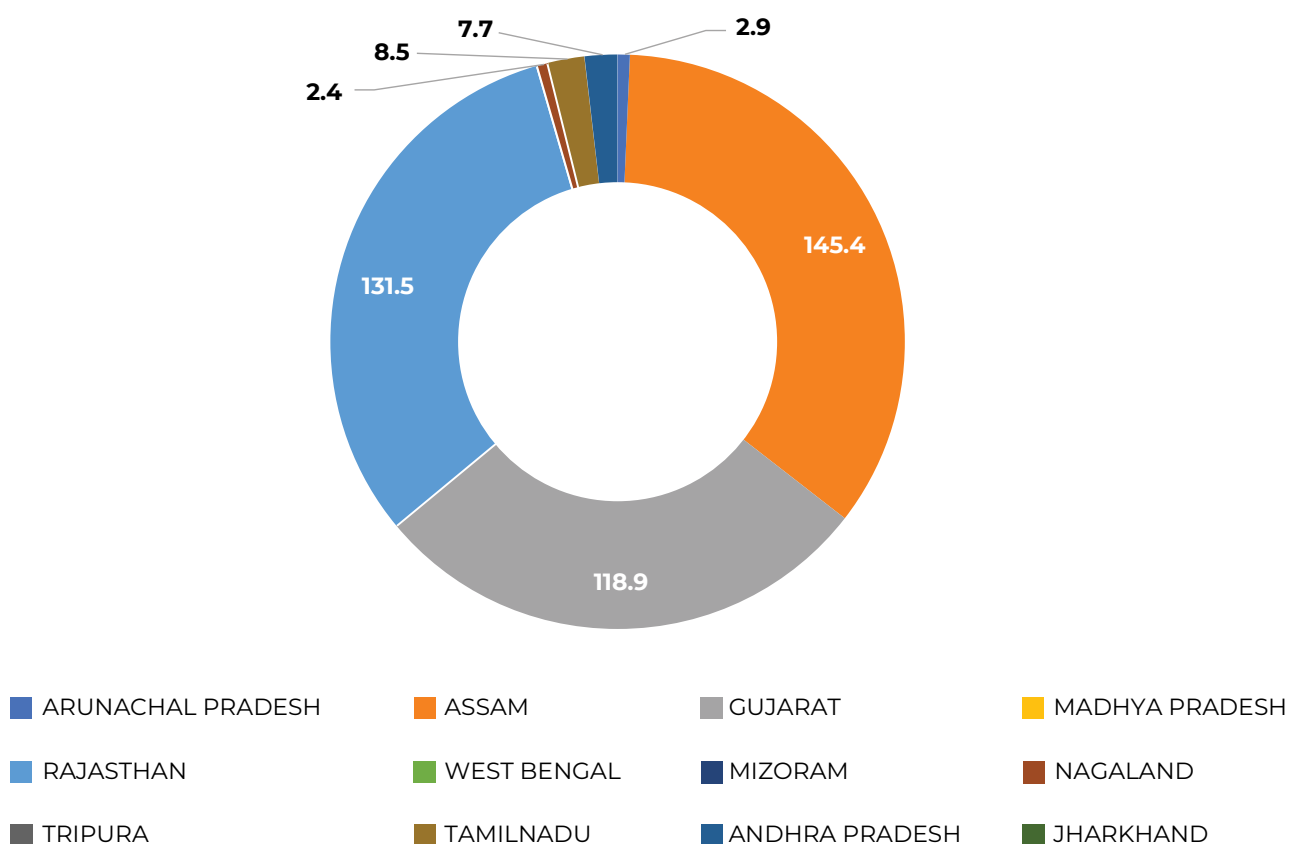


Table 5.3: Location-wise Gas (BCM) In-place-Reserves-Resources as of 01.04.2024

Location/State	2P In-Place	2P EUR	2P Reserves	2C Contingent Resources
ONLAND	1778.7	700.9	277.8	210.7
ARUNACHAL PRADESH	18.0	4.2	0.0	7.3
ASSAM	535.9	277.3	73.9	90.6
GUJARAT	274.5	135.9	36.5	19.0
MADHYA PRADESH	107.1	25.8	23.7	0.6
RAJASTHAN	166.3	73.4	49.5	14.1
WEST BENGAL	181.5	34.0	29.6	14.8
MIZORAM	0.0	0.0	0.0	0.00
NAGALAND	1.0	0.2	0.0	0.1
TRIPURA	97.3	40.5	16.5	11.7



Location/State	2P In-Place	2P EUR	2P Reserves	2C Contingent Resources
TAMILNADU	161.7	47.4	23.2	13.3
ANDHRA PRADESH	177.1	58.0	20.8	38.5
JHARKHAND	58.3	4.2	4.1	0.7
OFFSHORE	2222.4	1155.3	365.6	240.0
EASTERN OFFSHORE	567.9	261.8	136.0	127.3
WESTERN OFFSHORE	1654.5	893.5	229.6	112.7
Grand Total	4001.1	1856.1	643.4	450.8

Note: As per data received from NOCs and Private/JV Companies

Figure 5.7: Location-wise Gas (BCM) In-place-Reserves-Resources across country as of 01.04.2024

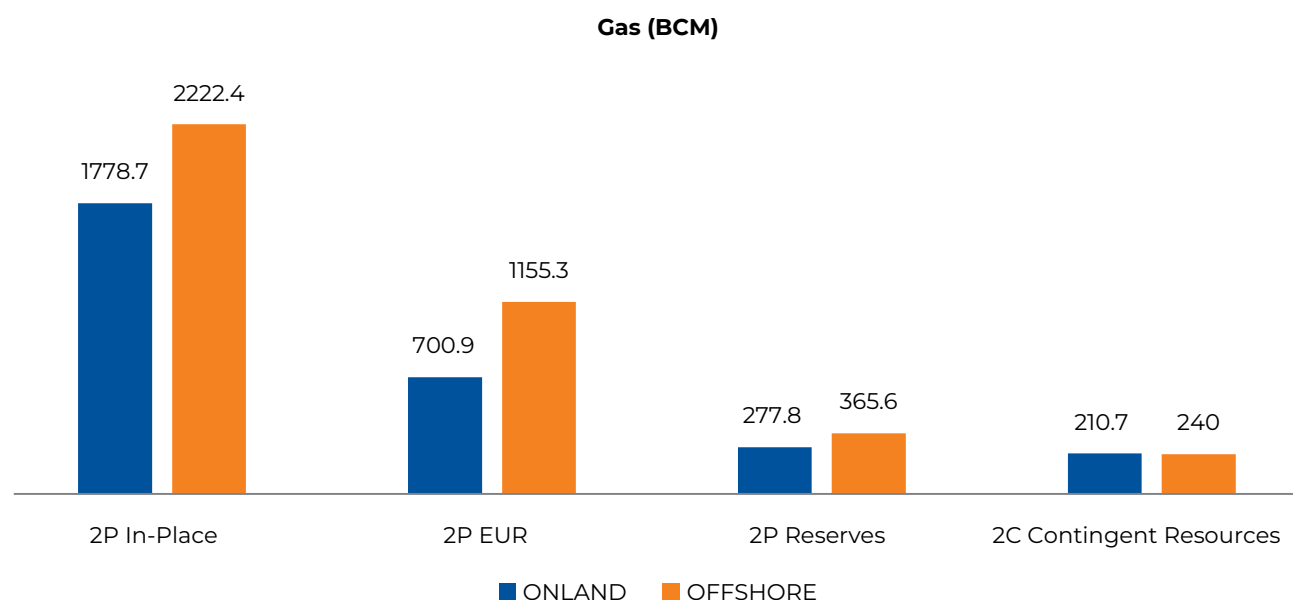
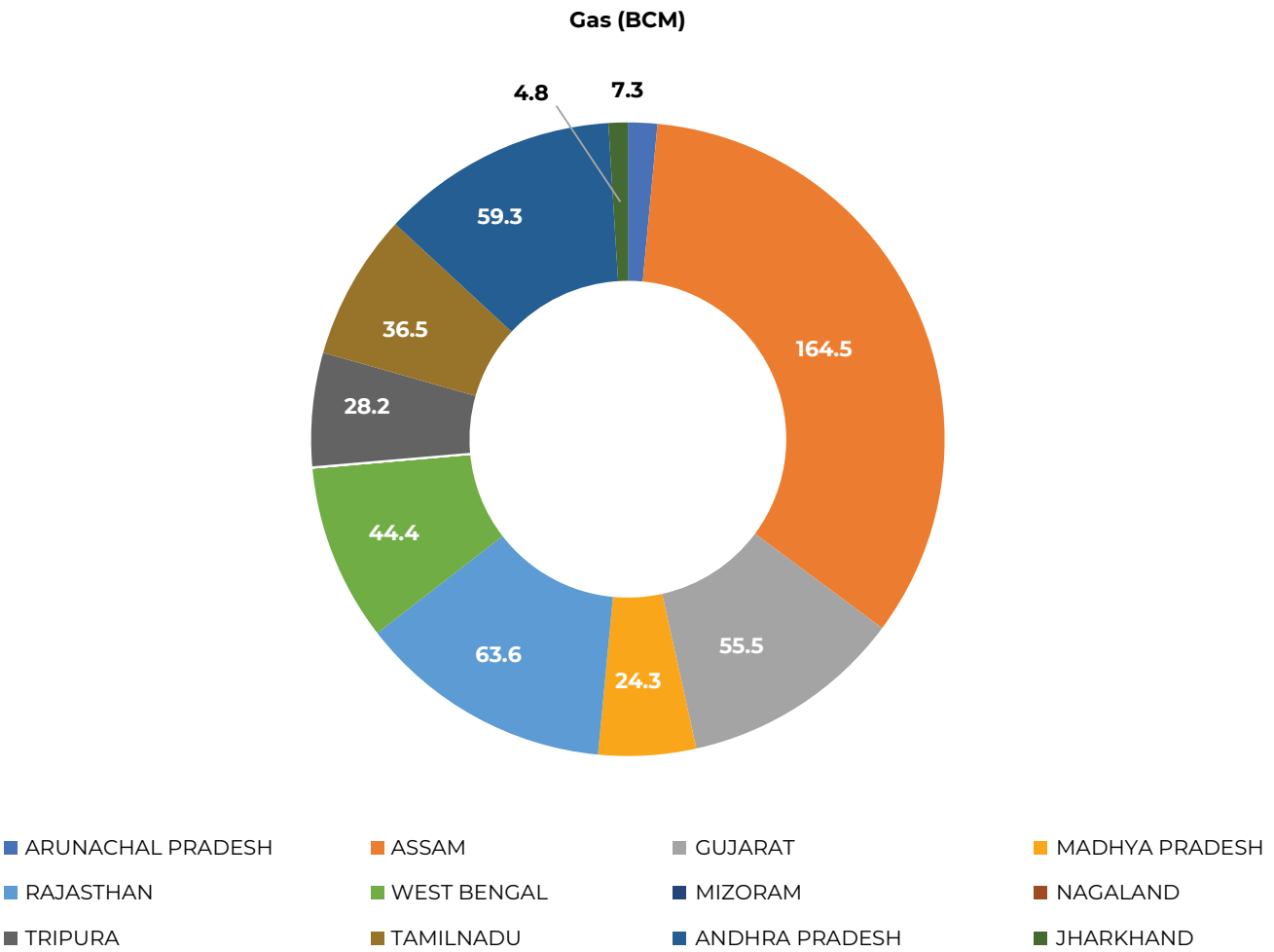


Figure 5.8: State-wise Onland Gas (BCM) 2P Reserves + 2P Resources across country as of 01.04.2024



India's Reserve Replacement Ratio (RRR) & Reserves to Production ratio (R/P)

Reserves Replacement Ratio (RRR) for a particular year in following manner:

$$RRR = \frac{[(\text{Reserves accreted}) / (\text{total production})]}{\text{during a FY}}$$

Change in EUR (Production+ reserves) denotes reserves accretion (+ve/-ve) during a financial year.

Country's RRR FY 2023-24	
Oil + Condensate	Gas
0.51	0.99



The Reserves-to-Production ratio (R/P) is an estimate of the number of years oil and gas reserves will continue to produce based on

current production rates. It does not account for future reserve accretion; hence it tends to increase with the time.

R/P = [total reserves / total production during a FY Year

Country's R/P FY 2023-24	
Oil + Condensate	Gas
16 years	18 years

Review of Enhanced Recovery (ER) Policy 2018 by Expert Committee

Government of India had issued a "Policy framework to promote and incentivize Enhanced Recovery Methods for Oil & Gas" to provide fiscal incentives to adopt Enhanced Recovery (ER), Improved Recovery (IR) and Unconventional Hydrocarbon (UHC) production methods in October 2018 with a well-laid provision for its review after 5 years.

Accordingly, an Expert Committee was constituted by MoPNG in June 2023 for identifying shortcomings and challenges in the

ER Policy 2018 and suggest necessary changes so that E&P Operators can be encouraged to implement the policy framework on a fast track realizing the given incentives.

The Expert Committee is chaired by Shri Omkar Nath Gyani, Director(Operations), ONGC Videsh Limited and amongst other members, it is represented by HoD(Reservoir) from DGH. The Committee successfully completed the task within 2 months and submitted the draft Modified ER Policy, 2023 with its recommendations. The gazette notification is due for approval from MoPNG.



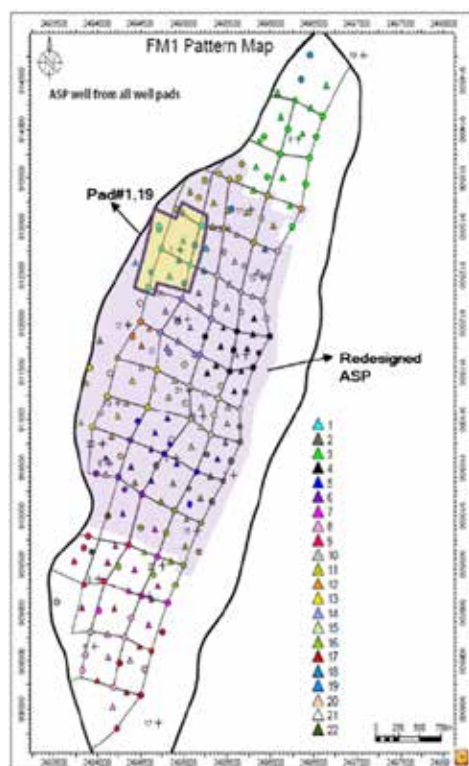
Director (operations), OVL handing over the modified draft ER Policy 2023 to Joint Secretary, MoPNG on 11.08.2023



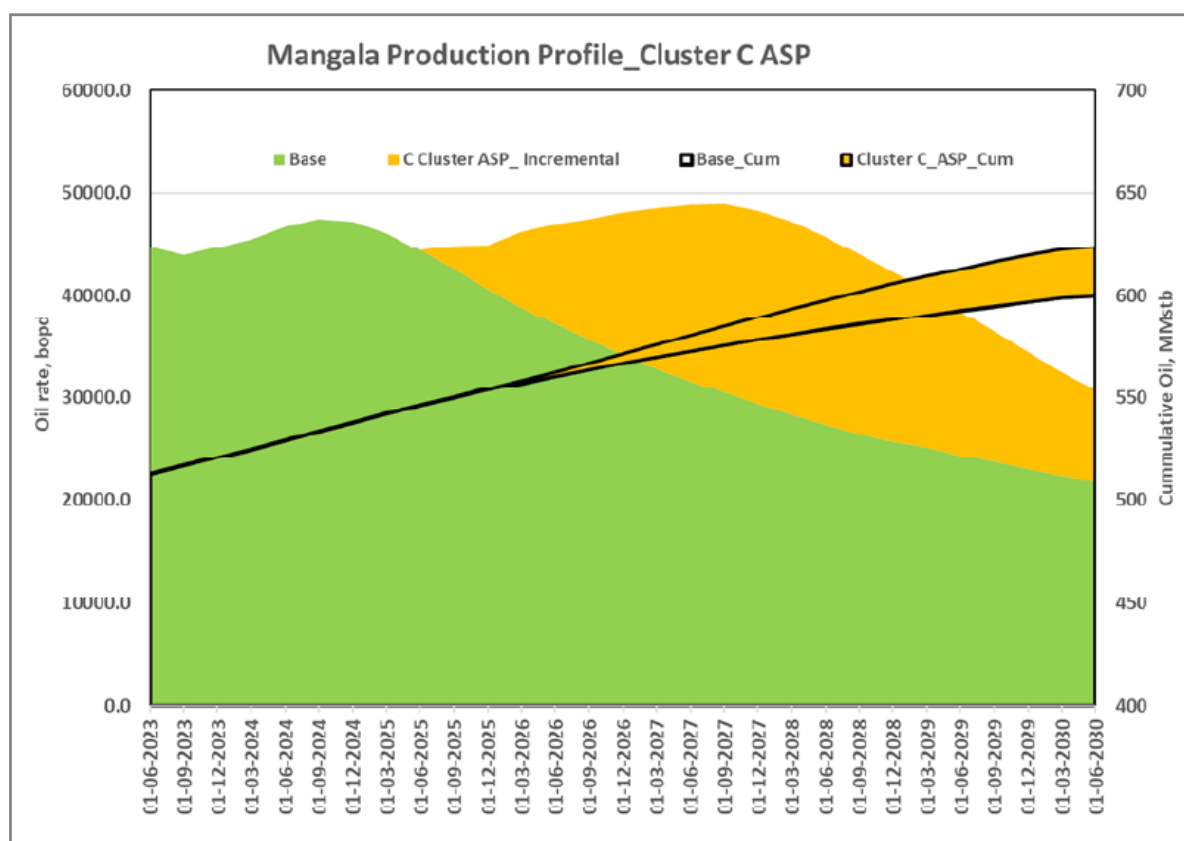
Enhanced Recovery (ER) incentive approval of Commercial Projects:

DGH has approved ER incentives for 2 projects against incremental oil through ER method as per the ER policy 2018. However, the calculations for incremental oil gain is done as recommended in Draft modified ER policy 2023.

- a) Operator Vedanta for **Mangala field ASP (Alkaline surfactant polymer)** project - the total incremental EUR from ASP flooding is estimated to be ~6.5 MMbbl. The Commercial implementation of the project has been started.
- b) Operator ONGC for **Becharaji Polymer flood** project- the total incremental EUR from polymer flooding is estimated to be 3.1 MMbbl. The Commercial implementation of the project has been started.



Projection of Incremental oil gain through ASP in Mangala field





EOR Pilot facility



6

New Investment Opportunities in E&P Sector



Introduction

Since 1999, the New Exploration Licensing Policy (NELP) had governed oil and gas exploration and production. Its cornerstone, the Production Sharing Contracts (PSCs), operated on a profit-sharing basis, necessitating extensive governmental micromanagement for cost control and revenue maximization. However, administering these contracts proved problematic, spawning disputes and arbitrations with the contractors. Issues encompassed cost recovery limits, procurement challenges, investment multiples calculation methodology, and a lack of operator incentives for cost containment, all detrimentally affecting profit petroleum.

Further, separate policies and fiscal terms were formulated to administer various hydrocarbon types, including CBM, shale oil/gas, and conventional hydrocarbons, fostering inefficiencies in resource exploitation. Under NELP, exploration was confined to government-offered blocks, constraining access to potentially lucrative opportunities



Transitioning from NELP to the Revenue Sharing Contract (RSC) regime marks a pivotal shift in India's oil and gas sector



in other unexplored areas. To tackle these systemic and operational shortcomings, the government introduced a Revenue Sharing Contract Regime, heralding significant policy overhauls.

Two major policies were formulated to implement the Revenue Sharing Contract Mechanism are Discovered Small Field Policy & Open Acreage Licence Policy.

a. Discovered Small Field Policy, 2015 to target the unpursued discoveries

The Discovered Small Field (DSF) Policy introduced by the Government of India in 2015 falls under the broader framework of the Hydrocarbon Exploration and Licensing Policy (HELP). The Cabinet Committee on Economic Affairs (CCEA) gave its nod to the policy on September 2, 2015, followed by formal notification on October 14, 2015. The primary objective of the DSF Policy is to reduce India's dependence on hydrocarbon imports and efficiently exploit established reserves by making unmonetized discovered fields available for exploration and production activities. This policy is designed to attract investments and technology, both from domestic and foreign sources, to tap into the untapped potential of small and marginal fields while operating under a Revenue Sharing regime.

Key points about the DSF Policy include:

- **Reduction in Import Dependency:** One of the main goals of the DSF Policy is to decrease India's reliance on imported hydrocarbons. By developing and producing from small & medium unmonetized discovered fields within the country, India aims to enhance its energy security.
- **Utilization of Established Reserves:** The DSF Policy targets discovered fields that have not been fully exploited or monetized. These fields may contain valuable hydrocarbon resources that can be harnessed for domestic consumption.

- **Attracting Investments and Technology:** To achieve its objectives, the DSF Policy seeks to attract investments and advanced technologies from both domestic and international companies. This is expected to contribute to the development of the oil and gas sector in India.
- **Revenue Sharing Regime:** Under the DSF Policy, contracts are typically awarded through a revenue-sharing mechanism. This means that operators will share a portion of their revenue with the government, which can provide a stable and transparent framework for investment.

The DSF Policy represents a significant step in India's energy strategy, aiming to leverage its domestic hydrocarbon resources more effectively, reduce import dependency, promote small and Private Operators, and foster investment and technology transfer in the energy sector. The DSF Bid Round-I, launched on May 25, 2016, marked the onset of a new era in the country's oil and gas sector.

Following the successful implementation of DSF Bid Round-I, the Cabinet Committee on Economic Affairs (CCEA) in its meeting dated 7th February 2018 approved extension of this Policy to include un-monetized discoveries/ small fields from Production Sharing Contract (PSC) regime along with un-monetized



discoveries of Nomination regime. Government also decided to extend the DSF Policy for future bidding rounds. The DSF Policy extension was notified vide Notification No. O-31018/149/2016-ONG-III dated 5th April 2018.

Salient Fiscal and Policy features of DSF Policy

The DSF Policy of 2015 introduced several important features to incentivize investment and exploration in India's hydrocarbon sector:

- **No Oil Cess** The policy exempted crude oil production from the payment of oil cess, which reduces the financial burden on producers and encourages investment in exploration and production activities.
- **Moderate Royalty Rates** The policy set moderate royalty rates, which are fees paid to the government for the right to extract hydrocarbons. This balanced approach helps to attract investors while ensuring government revenue.
- **Exemption from Custom Duty** Companies operating under the DSF Policy enjoy exemptions from custom duties, making it more cost-effective to import equipment and technology required for exploration and production.
- **No Upfront Signature Bonus** Unlike traditional bidding processes, the DSF Policy does not require an upfront signature bonus, reducing the financial burden on operators during the initial stages of exploration and production.
- **Pricing and Marketing Freedom** Operators are granted pricing and marketing freedom for oil and gas, allowing them to determine the pricing of their products and explore various marketing strategies.
- **No Carried Interest by NOCs** The policy does not require National Oil Companies (NOCs) to hold a carried interest in the projects, providing more autonomy to contractors.
- **Single PML License** The DSF Policy offers a single Petroleum Mining Lease (PML) license that covers both conventional and non-conventional hydrocarbons. This simplifies administrative processes for operators.
- **Flexibility in Exploration Activities** During the contract period, there are no restrictions on exploration activities, allowing operators to adapt their strategies based on evolving conditions and information.
- **Experience** No technical experience required, up to 100% participation by foreign companies are also allowed.

The DSF Policy has been implemented through International Competitive Bidding (ICB) processes, enabling Indian and foreign investors and companies to participate in the development of un-monetized discovered hydrocarbon resources. This has led to the entry of about **29 new players** in the Indian Exploration and Production (E&P) sector.

🕒 Bid Rounds under the DSF Policy, within RSC Framework

As of now, three (3) DSF bidding rounds have been conducted, offering a total of 103 Contract Areas encompassing 201 discoveries across 10 sedimentary basins (7 Category-I and 3 Category-II basins) covering approximately 17,593 square kilometres of area. Out of these, 85 Contract Areas have been awarded to about 35 Indian and foreign companies, covering approximately 16,508 square kilometres of area. These awarded Contract Areas encompass 175 discoveries with the estimated potential In-place reserves are about 464 Million Metric Tonnes of oil equivalent (MMtoe), contributing significantly to India's hydrocarbon resource development. The DSF Policy has thus played a crucial role in attracting investment and enhancing domestic hydrocarbon production. Salient details of different DSF Bid rounds are as under:



i. Discovered Small Field Bid Round-I (2016)

The DSF Bid Round-I launched on May 25, 2016, as part of Hon'ble Prime Minister's overarching vision to reduce India's dependence on imported Oil and Gas. During this round, Government of India offered 46 Contract Areas with 67 discoveries across nine sedimentary basins, covering about 1,551 square kilometres of area and having 86 Million Metric Tonnes (O+OEG) of in-place reserves.

As a result of DSF Bid Round-I, the Government of India awarded 30 Contract Areas, and the Revenue Sharing Contract (RSC) for awarded Contract Areas were signed on March 27, 2017. These 30 Contract Areas, including 23 onshore and 07 shallow offshore blocks with 43 discoveries across nine sedimentary basins, covering approximately 777 square kilometres of area and having 44.66 Million Metric Tonnes (O+OEG) of in-place reserves.

Key Highlights of DSF Bid Round-I are as outlined below:

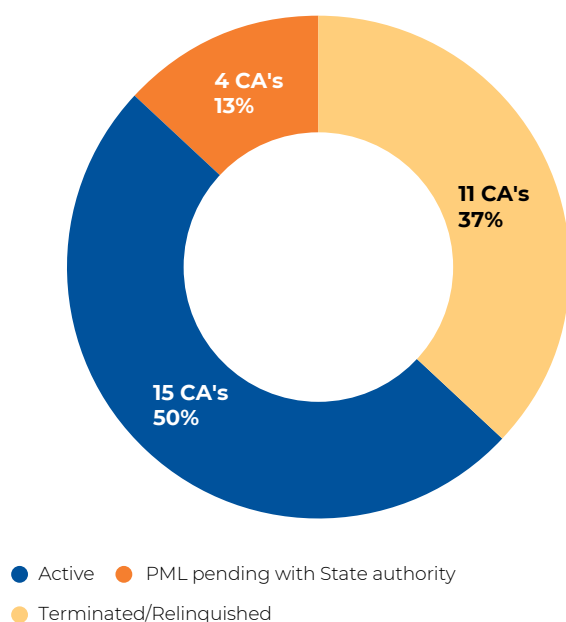
- A total of 134 bids were received for 34 contract areas.
- The bidding process was transparent and conducted through an online bidding portal, with strong handholding support provided to bidders and investors. The bid round was concluded in a record time of 10 months.
- Prior technical experience was not a pre-qualification criterion.
- Twenty-two (22) companies, either singly or in consortium, were shortlisted for 31 contract areas. Of these 22 companies, 15 were new entrants to the E&P sector.
- 30 Contract Areas (23 onshore and 07 offshore) were successfully awarded. Twenty companies, either singly or in consortium, signed the RSC on March 27, 2017. Of these 20 companies, 13 were new entrants to the Indian E&P industry.

Table 6.1: Status of Contract Areas awarded under DSF Bid Round-I

Sl. No.	Basin	Basin Category	Contract Areas awarded under DSF Bid Round-I			
			Active	PML Awaited	Terminated/ Relinquished	Total
1	Assam Shelf	Cat-I	5	1	1	7
2	Assam- Arakan fold belt				2	2
3	Cambay		5			5
4	Krishna Godavari		3	1	1	5
5	Mumbai Offshore		2		3	5
6	Cauvery			2		2
7	Rajasthan			2	2	
8	Kutch Offshore	Cat-II			1	1
9	Vindhyan				1	1
Grand Total			15	4	11	30



Figure 6.1: Status of Contract Areas awarded under DSF Bid Round-I



ii. Discovered Small Field Bid Round-II (2018)

Following the successful implementation of DSF Bid Round I in 2016, the Government of India extended the DSF Policy of 2015 for future rounds in April 2018. This extension maintained the benefits of the original policy while reducing the royalty rates to align with the Hydrocarbon Exploration & Licensing Policy (HELP).

The DSF Bid Round-II launched on August 09, 2018. During this round, Government of India offered 25 Contract Areas with 59 discoveries across seven sedimentary basins, covering about 3,042 square kilometres of area and having 190 Million Metric Tonnes (O+OEG) of in-place reserves.

As a result of DSF Bid Round-II, the Government of India awarded 24 Contract Areas, and the Revenue Sharing Contract (RSC) for 23 no's of awarded Contract Areas were signed on March 07, 2019 with the successful awardee companies. Additionally, the Revenue Sharing Contract for one Contract Area was signed in January 2021 with a successful awardee company. These 24 Contract Areas, including 15 onshore and 09 shallow offshore blocks with 58 discoveries

across seven sedimentary basins, covering approximately 3,004 square kilometres of area and having 188.9 Million Metric Tonnes (O+OEG) of in-place reserves.

A total of 145 e-bids were received: 103 for onshore contract areas and 42 for offshore areas. The round attracted participation from 40 companies, either individually or as part of consortia, including six foreign companies from the USA, UK, Australia, Singapore, and UAE.

DSF Bid Round II saw significant interest from both new entrants in India and international players. After a detailed evaluation, 14 companies (either individually or in consortia) were shortlisted for 23 contract areas, with eight of these companies being new entrants to the E&P sector.

The DSF Round II was designed to provide industry professionals the opportunity to invest in larger areas within already discovered basins, offering minimal-risk investment opportunities. The entire bidding process was conducted digitally through a secure, transparent, and user-friendly e-bidding portal.

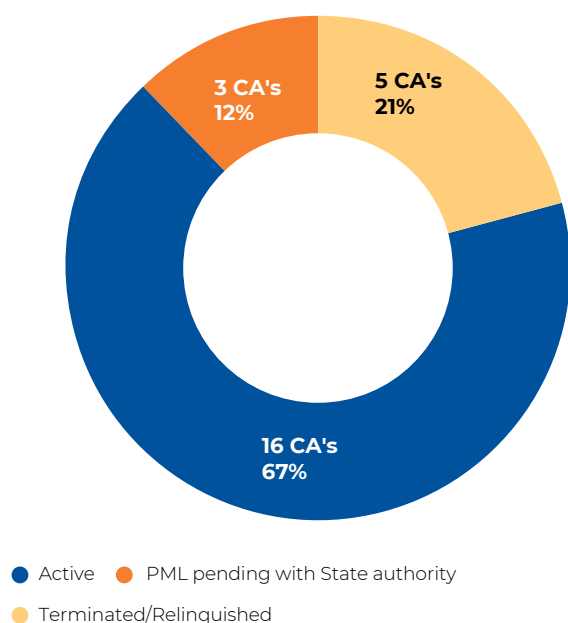
Key highlights of DSF Bid Round II include:

- A total of 145 bids were received for 24 contract areas, with no bids for one area.
- 40 companies participated, either individually or as part of consortia.
- Six foreign companies showed significant interest.
- 14 companies were shortlisted for 23 contract areas after a rigorous evaluation, with eight being new to the E&P sector.
- As a result, 23 Revenue Sharing Contracts, covering 57 discoveries, were signed on March 7, 2019.
- Additionally, Revenue Sharing Contract for one Contract Area, covering 1 discovery, was signed in January 2021 with a successful awardee company.



Table 6.2: Status of Contract Areas awarded under DSF Bid Round-II

Sl. No.	Basin	Basin Category	Contract Areas awarded under DSF Bid Round-II			
			Active	PML Awaited	Terminated/ Relinquished	Total
1	Mumbai	Cat-I	6			6
2	Krishna Godavari		2	3	1	6
3	Assam Shelf		3		2	5
4	Assam- Arakan fold belt		1			1
5	Cambay		2		2	4
6	Rajasthan		1			1
7	Bengal-Purnea	Cat-II	1			1
Grand Total			16	3	5	24

Figure 6.2: Status of Contract Areas awarded under DSF Bid Round-II

on June 10, 2021. During this round, Government of India offered 32 Contract Areas with 75 discoveries across nine sedimentary basins (including 7 Category-I and 2 Category-II Basin), covering about 13,000 square kilometres of area and having 232 Million Metric Tonnes (O+OEG) of in-place reserves. A total of 107 bids were received for 32 contract areas.

As a result of DSF Bid Round-III, the Government of India awarded 31 Contract Areas, and the Revenue Sharing Contract (RSC) for awarded Contract Areas were signed on September 09, 2022 with the successful awardee companies. These 31 Contract Areas, including 11 onshore and 20 offshore blocks, with 74 discoveries across nine sedimentary basins, covering approximately 12,727 square kilometres of area and having 230 Million Metric Tonnes (O+OEG) of in-place reserves.

iii. Discovered Small Field Bid Round-III (2021)

Building on the achievements of the preceding DSF Bid Round-I (2016) and DSF Bid Round-II (2018), and recognizing the wealth of untapped discoveries, the DSF Bid Round-III commenced

During DSF Bid Round-III, some additional provisions and incentives were designed to encourage exploration and production activities in the oil and gas sector.



Table 6.3: Revised Provisions of DSF - III

Feature	Previous Provision	Revised Provision
Bidding Parameter	Weightage: Biddable Work Program: 20% Govt. Revenue Share : 80% No HRP Ceiling	Weightage: Biddable Work Program: 50% Govt. Revenue Share : 50% HRP Upper Ceiling : 50%
Early Production	No Incentive	Incentivizing early commercial production during development period (Oil: Min of 5 US\$/bbl and Quoted LRP) (Gas: Min of 0.2 US\$/MMBtu and Quoted LRP)
Liquidated Damage (LD)	High LD in case of failing to meet Minimum Work Programme	75% reduction in LD amount
Exit Option	No Provision	Option to exit without LD Payment in case of delay in statutory clearances beyond 2 years

Key highlights of DSF Bid Round-III are as follows:

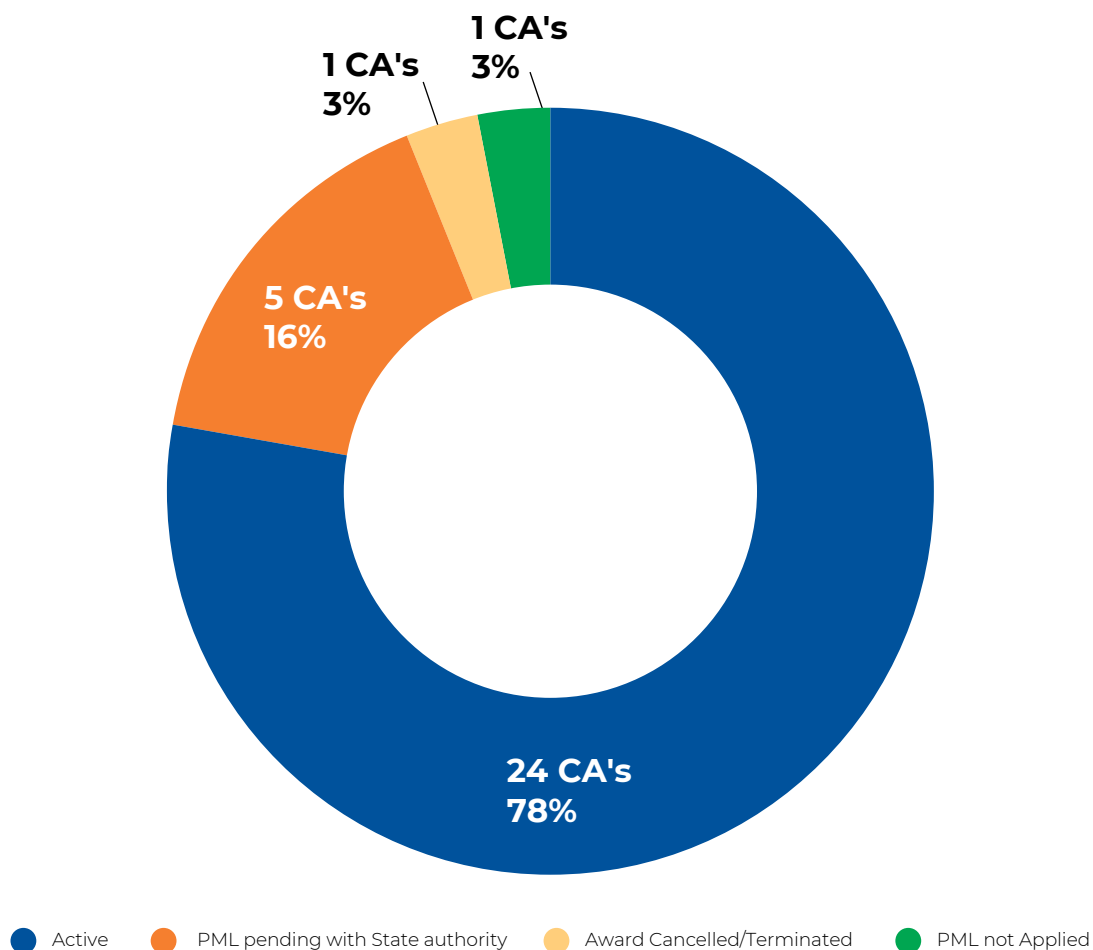
- Enhanced Investor Confidence and Increased Participation** The DSF-III bid round saw a remarkable turnout of 107 bids for 32 Contract Areas, with the participation of 27 companies, of which 23 were private players. This increased participation has enhanced investor confidence in the sector.
- New Entrants** Five new entrants, including two foreign companies, have entered the Indian E&P sector through this bidding round, demonstrating a growing international interest in the Indian hydrocarbon industry.
- Move Towards Blue Economy** A noteworthy aspect of this bid round is that approximately 90% of the hydrocarbon resources offered are in the Indian offshore region, signaling a move towards a blue economy.
- Attractive Terms** The terms offered in this bid round are particularly appealing, with the issuance of a PML grant letter in offshore Contract Areas alongside the contract signing and incentivization for early monetization, further encouraging investment in the E&P sector.

- Data Sharing on Fast-Track Basis** Data can be a crucial component for companies involved in oil and gas exploration. Such facilitation allows them to access relevant geological and geophysical data more quickly, which can aid in decision-making and reduce exploration & production costs.



Table 6.4: Status of Contract Areas awarded under DSF Bid Round-III

Sl. No.	Basin	Basin Category	Contract Areas awarded under DSF Bid Round-III				
			Active	PML Awaited	Award cancelled/ Terminated	PML not applied	Total
1	Krishna Godavari	Cat-I	6	3		1	10
2	Mumbai Offshore		8		1		9
3	Cambay		3				3
4	Assam- Arakan fold belt		2				2
5	Assam Shelf		1				1
6	Rajasthan		2				2
7	Cauvery				1		1
8	Kutch Offshore	Cat-II	2				2
9	Vindhyan			1			1
Grand Total			24	5	1	1	31

Figure 6.3: Status of Contract Areas awarded under DSF Bid Round - III

Consolidated Status of DSF Bid Rounds

The Contract Areas awarded under DSF regimes are as under:

Table 6.5: Combined Status of DSF Contract Areas

Sl. No.	STATE	CONTRACT AREA	DSF-I	DSF-II	DSF-III	Total	
1	MUMBAI OFFSHORE	MB/OSDSF/B-37/2016	5			20	
		MB/OSDSF/B127E/2016					
		MB/OSDSF/B15/2016					
		MB/OSDSF/B80/2016					
		MB/OSDSF/B9/2016					
		MB/OSDSF/CA/2018					
		MB/OSDSF/D18/2018					
		MB/OSDSF/D31/2018		6			
		MB/OSDSF/D33/2018					
		MB/OSDSF/NMT/2018					
		MB/OSDSF/SB15/2018					
		MB/OSDSF/B15/2021					
		MB/OSDSF/B154N/2021					
		MB/OSDSF/B174/2021					
		MB/OSDSF/B203/2021					
		MB/OSDSF/B37/2021			9		
		MB/OSDSF/B66/2021					
		MB/OSDSF/BH68/2021					
		MB/OSDSF/Ratna/2021					
		MB/OSDSF/WO5/2021					
2	ASSAM	AA/ONDSF/BARSILLA/2016	8			16	
		AA/ONDSF/CHARAIDEO/2016					
		AA/ONDSF/DIPLING/2016					
		AA/ONDSF/DUARMARA/2016					
		AA/ONDSF/HILARA/2016					
		AA/ONDSF/JERAIPATHAR/2016					
		AA/ONDSF/LAXMIJAN/2016					
		AA/ONDSF/PATHARIA/2016					



Sl. No.	STATE	CONTRACT AREA	DSF-I	DSF-II	DSF-III	Total
		AA/ONDSF/Tiphuk/2018				
		AA/ONDSF/Disaijan/2018				
		AA/ONDSF/Hazarigaon/2018		5		
		AA/ONDSF/Madhakali/2018				
		AA/ONDSF/Umatara/2018				
		AA/ONDSF/PATHARIA/2021				
		AA/ONDSF/TIPHUK/2021			3	
		AA/ONDSF/TUKBAI/2021				
3	ANDHRA PRADESH	KG/ONDSF/ACHANTA/2016				
		KG/ONDSF/BHIMANAPALLI/2016	4			
		KG/ONDSF/KORAVAKA/2016				
		KG/ONDSF/SANARUDRAVARAM/2016				11
		KG/ONDSF/Gokarnapuram/2018				
		KG/ONDSF/Kaza/2018		4		
		KG/ONDSF/Palakollu/2018				
		KG/ONDSF/Suryaraopeta/2018				
		KG/ONDSF/DANGERU/2021				
		KG/ONDSF/KAVITAM/2021			3	
		KG/ONDSF/Sanarudravaram/2021				
4	GUJARAT	CB/ONDSF/ELAO/2016				
		CB/ONDSF/KAMBOI/2016				
		CB/ONDSF/KHAMBEL/2016	5			
		CB/ONDSF/SOUTH PATAN/2016				
		CB/ONDSF/WEST BECHRAJI/2016				10
		CB/ONDSF/AI/2018				
		CB/ONDSF/D45/2018		4		
		CB/ONDSF/SANGANPUR/2018				
		CB/ONDSF/VADATAL/2018				
		CB/ONDSF/INDRORA/2021			1	



Sl. No.	STATE	CONTRACT AREA	DSF-I	DSF-II	DSF-III	Total
5	KG OFFSHORE	KG/OSDSF/GSKV1/2016	1			10
		KG/OSDSF/G4/2018		2		
		KG/OSDSF/GSKW/2018				
		KG/OSDSF/G4/2021				
		KG/OSDSF/GS21/2021				
		KG/OSDSF/CHANDRIKA/2021				
		KG/OSDSF/GS49/2021			7	
		KG/OSDSF/YS6/2021				
		KG/OSDSF/RAVVA/2021				
		KG/DWDSF/GD10/2021				
6	RAJASTHAN	RJ/ONDSF/BAKHRI TIBBA/2016	2			5
		RJ/ONDSF/SADEWALA/2016				
		RJ/ONDSF/Chinnewala/2018		1		
		RJ/ONDSF/BakhriTibba/2021			2	
		RJ/ONDSF/Punam/2021				
7	TAMIL NADU	CY/ONDSF/KARAIKAL/2016	2			3
		CY/ONDSF/NEDUVASAL/2016				
		CY/ONDSF/VADATHERU/2021			1	
8	KUTCH OFFSHORE	GK/OSDSF/KD/2016	1			3
		GK/OSDSF/GK1/2021			2	
		GK/OSDSF/GK28/2021				
9	MADHYA PRADESH	VN/ONDSF/NOHTA/2016	1			2
		VN/ONDSF/NOHTA/2021			1	
10	TRIPURA	AA/ONDSF/Tulamara/2018		1		1
11	ARUNANCHAL PRADESH	AA/ONDSF/KHEREM/2016	1			1
12	CAMBAY OFFSHORE	CB/OSDSF/AMBE/2021			2	2
		CB/OSDSF/GULFA/2021				
13	MAHANADI OFFSHORE	NEC/OSDSF/D11/2018		1		1
Grand Total			30	24	31	85



The information about the area and Hydrocarbon potential awarded in DSF regimes are as under;

Figure 6.4: Snapshot of DSF Contrat Areas

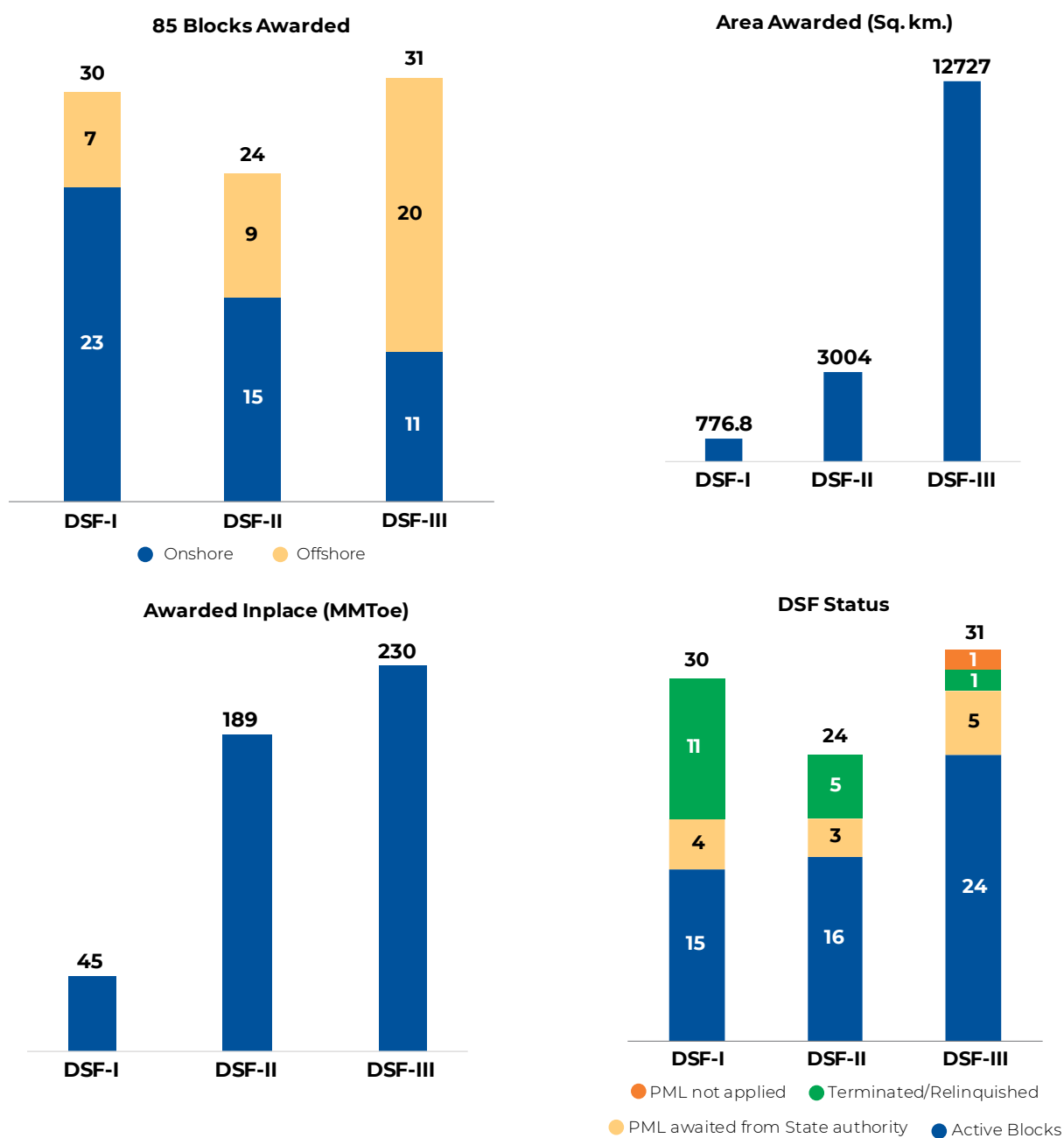
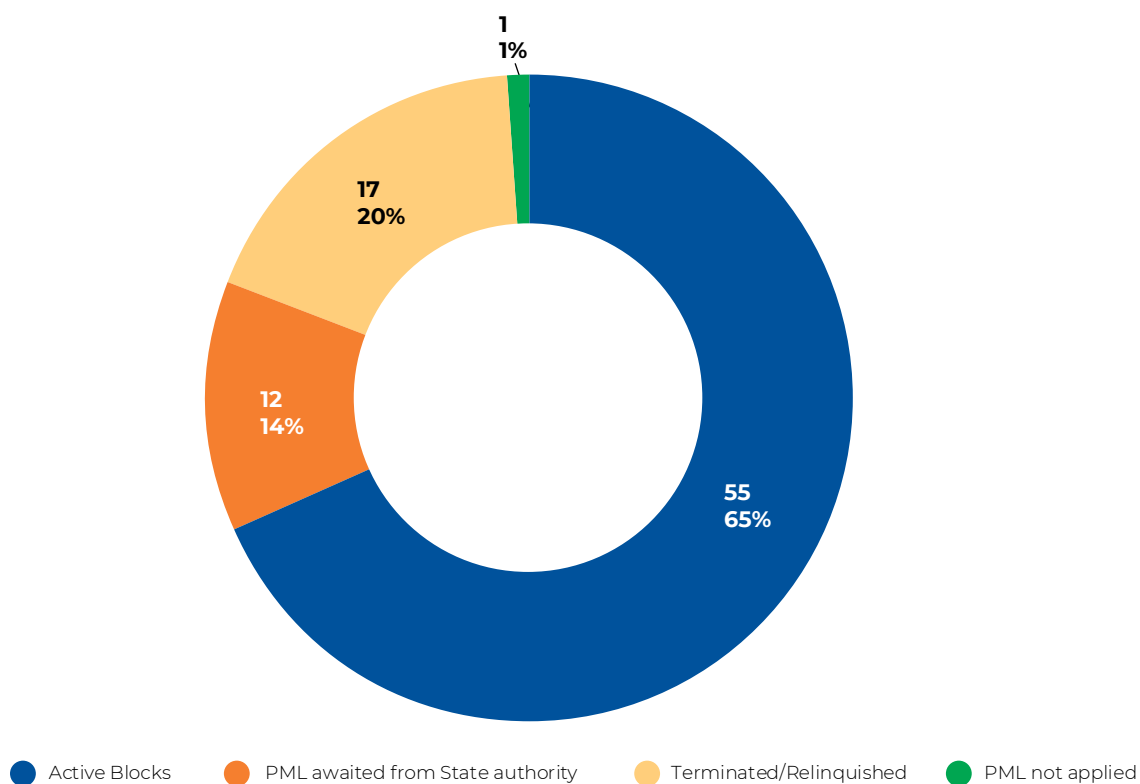


Figure 6.5: Status of awarded DSF Blocks**Table 6.6: Status of DSF I, II & III Contract Areas are as under:**

S. No	Status	DSF-I	DSF-II	DSF-III	Total
1	Awarded Contract Area (CA)	30	24	31	85
2	No of PMLs awaited	4	3	5	12
3	Relinquished Contract Area	6			6
4	Terminated Contract Areas	5	5	1*	11
5	PML not applied			1	1
6	Operational / Active	15	16	24	55

*for one Contract Area- Award cancelled by MoPNG



Table 6.7: State-wise status of Contract Areas awarded under DSF-I, II & III regime

DSF	States	Active	PML Awaited	Terminated/ Relinquished	PML not applied	Total
DSF-I	Assam	5		3		8
	Gujarat	5				5
	Andhra Pradesh	2	1	1		4
	Tamil Nadu		2			2
	Rajasthan			2		2
	Arunanchal Pradesh		1			1
	Madhya Pradesh			1		1
	Mumbai Offshore	2		3		5
	KG Offshore	1				1
	Kutch Offshore			1		1
DSF-I Total		15	4	11		30
DSF-II	Assam	3		2		5
	Gujarat	2		2		4
	Andhra Pradesh	1	3			4
	Rajasthan	1				1
	Tripura	1				1
	Mumbai Offshore	6				6
	KG Offshore	1		1		2
	Mahanadi Offshore	1				1
DSF-II Total		16	3	5		24
DSF-III	Assam	3				3
	Gujarat	1				1
	Andhra Pradesh		3			3
	Tamil Nadu		1			1
	Rajasthan	2				2
	Madhya Pradesh		1			1
	Mumbai Offshore	8		1		9
	KG Offshore	6			1	7
	Cambay Offshore	2				2
	Kutch Offshore	2				2
DSF-III Total		24	5	1	1	31



Figure 6.6: State-wise Distribution of Contract Areas awarded under DSF-I, II & III

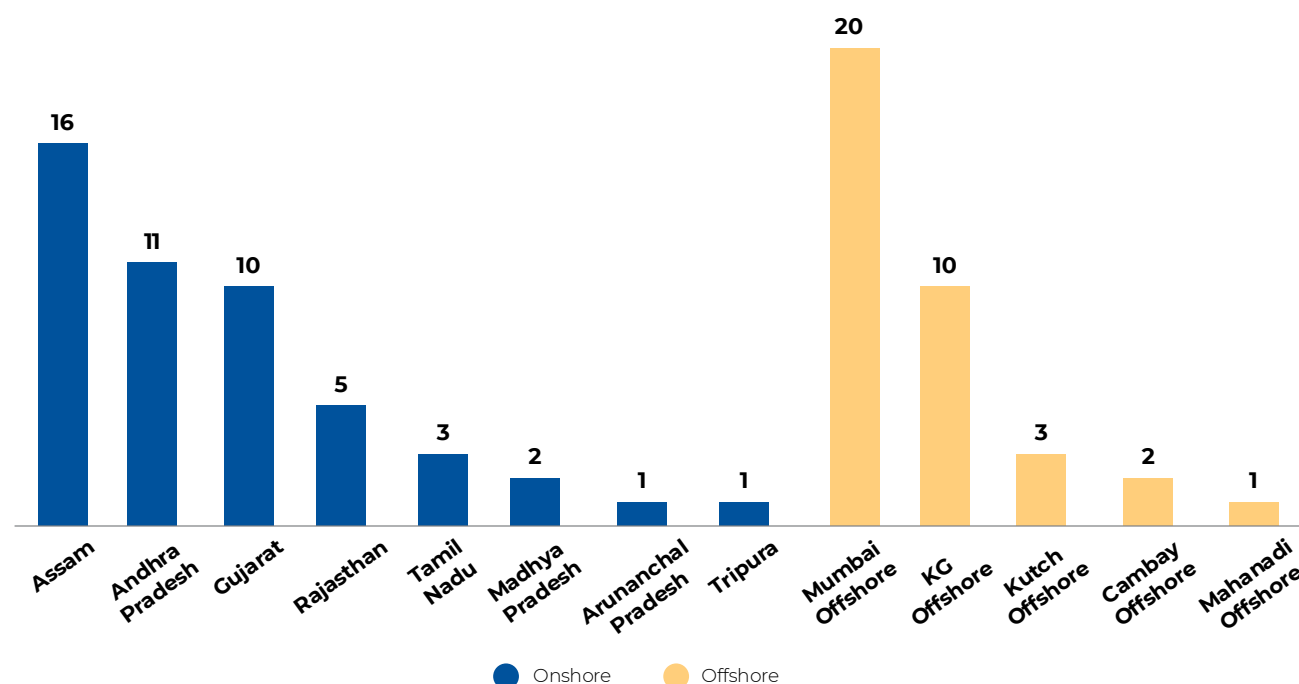


Figure 6.7: Basin-wise Distribution of Contract Areas awarded under DSF-I, II & III

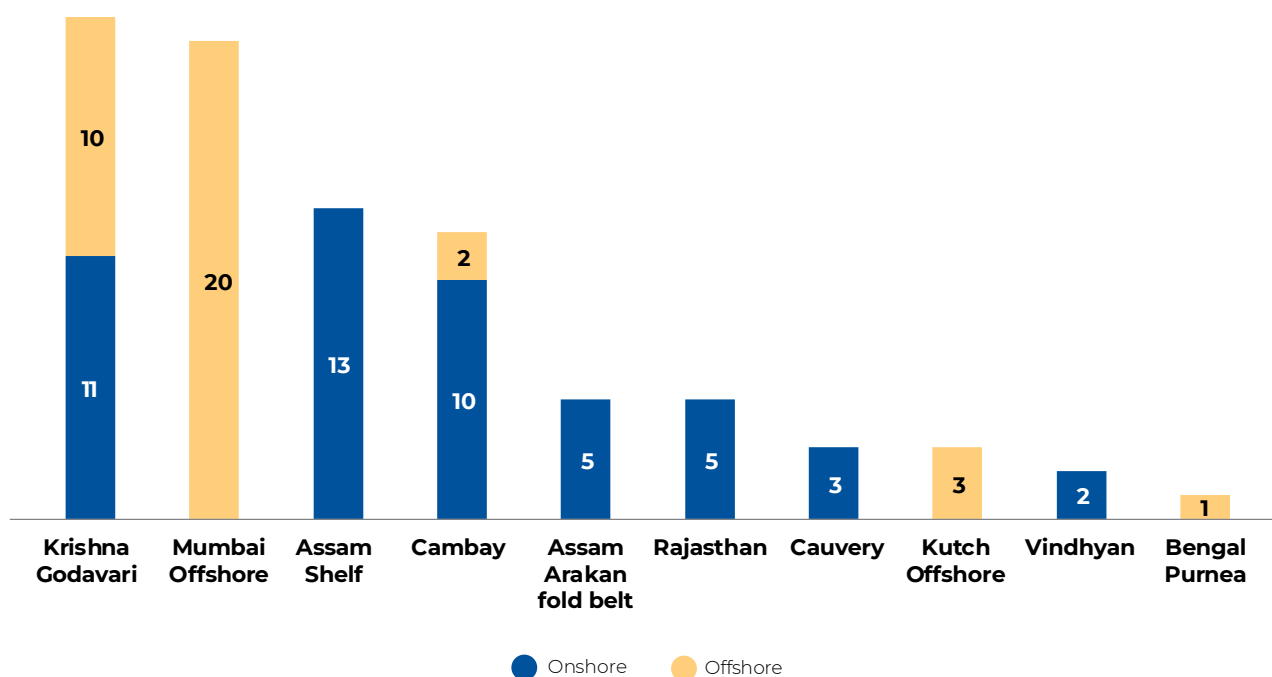


Table 6.8: State-wise status of PML granted to the Operators of DSF Blocks

Sl. No.	States	No. of Live* CAs under DSF regime	No of PML's granted/ Active CAs	PML Awaited	Area of Granted PML
1	Mumbai Offshore	16	16		6285.1
2	Assam	11	11		779.9
3	Gujarat	8	8		391.4
4	KG Offshore	8+1**	8		1563.5
5	Cambay Offshore	2	2		801.2
6	Andhra Pradesh	10	3	7	139.7
7	Tamil Nadu	3	0	3	0.0
8	Rajasthan	3	3		167.0
9	Arunachal Pradesh	1	0	1	0.0
10	Madhya Pradesh	1	0	1	0.0
11	Tripura	1	1		47.2
12	Kutch Offshore	2	2		2092.3
13	Mahanadi Offshore	1	1		541.4
Grand Total		68	55	12	12808.7

* Awarded Contract Areas excluding the Terminated/Relinquished Blocks.

** PML not yet applied.

HYDROCARBON EXPLORATION AND LICENCING POLICY (HELP)

The Government of India approved transformative licensing policy called a Hydrocarbon Exploration Licensing Policy (HELP) on 30th March 2016 for the award of exploration acreages to boost the Indian E&P Sector. Which led shift from Production Sharing mechanism to Revenue Sharing mechanism. It was a giant step towards improving the 'Ease of Doing Business' in the Indian Exploration and Production (E&P) sector as Government does not interfere in day-to-day business activities of Contractor. The Government of India introduced the Open Acreage Licensing (OAL) mechanism as a part of the HELP which gives exploration companies the option to select the exploration blocks on their own, without having to wait for the formal bid round from the Government. The first OALP Bid Round, under HELP, was

launched by the Government in January 2018. In a Six (6) year period, Eight OALP bid rounds have been concluded with the award of 144 exploration blocks covering 2,42,057 sq. km. area for E&P activities.

Policy Reform

HELP comes with attractive and liberal terms like reduced royalty rates, no oil cess, marketing and pricing freedom, freedom to investors for carving out blocks of their interest, a single license to cover both conventional and unconventional hydrocarbon resources, exploration permission during the entire contract period, and an easy, transparent and swift bidding and awarding process.



Salient features of HELP

- Opportunity to carve out blocks using National Data Repository (NDR) and Unified Licence for both conventional and unconventional Hydrocarbons
- Simple and easy to administer Revenue Sharing Model
- Low regulatory burden
- Easy entry and easy exit
- Complete transparency and time bound process
- Marketing and pricing freedom
- Reduced royalty regime for Ultra-Deep water and Deep water areas
- Exploration rights for full contract life

In order to make policy more attractive, Government further notified the policy reforms on 28th February 2019, where many of the processes and approvals were relaxed to promote "Ease of Doing Business". These reforms were focused to increase exploration activities, attract domestic and foreign investment in unexplored/unallocated areas of sedimentary basins. These reforms were made applicable from OALP Round IV onwards. Some of the features of policy reforms are as follows:

- More weightage to Work Programme than the Revenue Share for Category-I Basin.
- Revenue Share from Category II & III type of basins were removed except in case of windfall gain.
- Concession in Royalty rates
- Liberal freedom to Transfer/Exit the blocks
- No obligation to run Drill Stem Test
- Introduction of alternate dispute resolution mechanism and Empowered Coordination Committee (ECC) for expediting statutory clearances/approvals.

To enhanced the participation, the amendments in the bid documents for bid round VIII onwards has been carried out in May-

2023. For Category-II & III blocks only seismic work programme was biddable. The objective of such amendments is to address the issues of existing operators which they are facing in existing contractual framework and to make them compatible for the needs of global E&P players so that the bid documents can be made globally competitive.

Some of the key incentives are as follows:

- o Maximum Block size up to 20,000 sq.km is allowed to carved out for play based exploration
- o Scope of Force Majeure and Excusable delays enhanced
- o Stabilization period for revenue share at LRP rate increased up to 7 years
- o 3 Year Retention Period for Sub-Commercial Discoveries
- o Change in consortium is allowed prior to bidding, Free Basic Data package, Reduced Bid Bond, Rationalized Operatorship experience

For Category-II & III Basins some specific incentives were also provided which are as follows:

- o Extended exploration phase of 7 years period divided into two phases
 - Phase-I of 3 Years: Seismic Committed Work Programme
 - Phase-II shall be for a period of four (4) years for drilling exploratory wells
 - ⦿ 2 Years: 1 Exploratory Well Commitment
 - ⦿ 2 Years: 1 Exploratory Well Commitment
- o Bidding only on 2D & 3D Seismic with originator incentive of 10 points
- o Swapping of CWP with other surveys and Exploration Wells allowed

HELP is in line with GOI's policy of Minimum Government, Maximum Governance and Ease of Doing Business.



Bidding Process under OALP Regimes

OALP mechanism allow the investor to carve out the blocks of their choice by assessing E&P data available at National Data Repository (NDR) & by submitting an Expression of Interest (Eoi). OALP also encourages round the year submission of Expression of Interest (EOI) in 3 windows (April 1 to July 31, August 1 to November 30 and December 1 to March 31) by the interested bidders. The government. also launched state-of-art National Data Repository, a database comprising all the geo-scientific

data of hydrocarbon resources in the country, in 2017 in a bid to enable potential investors to take informed decisions.

Investor are given freedom to curve out the Eois as per Modalities. The submitted Eois will be scrutinized in accordance with the provisions of Modalities. Finalized Eois will be considered as Blocks and put-up for bidding. Contractor is required to submit the bid as per published NIO and modalities. Eoi originator is eligible for originator incentive.

A total of 30 Eois with an area of 2,25,110 sq.km have received in Eoi Window – XVI, XVII & XVIII during the FY 2023-24. The details are given below: -

Table 6.9: Eois Received in FY 2023-24

S.No.	Eoi Window	Period	No. of Eoi	Area
1	Eoi Window – XVI	01.04.2023-31.07.2023	21	202910
2	Eoi Window – XVII	01.08.2023-30.09.2023	5	16256
3	Eoi Window – XVIII	01.12.2023-31.03.2024	4	5944 (Under examination)

Summary of Participation

In Eight rounds of bid under OALP, 149 blocks were on offer and 144 exploration blocks covering an area of 2,42,056 sq. Km. were awarded to successful bidders. Five (5) un-

awarded blocks were offered under OALP-Round-III and in all of them CBM was focus; however, no bids were received for those CBM blocks. 252 bids were received for remaining 144 blocks that are spread over 19 Sedimentary Basins.

Table 6.10: Summary of participation in OALP rounds

OALP Bid Round	Blocks on offer	Number of participants	No. of bids	Area on offer (sq.km.)	Area awarded (sq.km.)	No. of Blocks Awarded
OALP-I	55	9	110	59,283	59,283	55
OALP-II	14	8	33	29,233	29,233	14
OALP-III	23*	5	42	31,722	29,765	18
OALP-IV	7	2	8	18,510	18,510	7
OALP-V	11	3	12	19,789	19,789	11
OALP-VI	21	3	24	35,346	35,346	21
OALP-VII	8	4	10	15,766	15,766	8



OALP Bid Round	Blocks on offer	Number of participants	No. of bids	Area on offer (sq.km.)	Area awarded (sq.km.)	No. of Blocks Awarded
OALP-VIII	10	6	13	34,365	34,365	10
Total	149	40	252	2,44,014	2,42,057	144

* No bid received for five CBM Blocks.

Overall awarded area of 2,42,056 sq. Km is split in to three categories of sedimentary basins as follows:

Table 6.11: Basin-wise area awarded under OALP rounds

Category of Basin	Number of Blocks	Area (Sq. km.)	% of area
Category-I	100	117425	48.51%
Category-II	29	85580	35.36%
Category-III	15	39051	16.13%
Grand Total	144	2,42,056	100%

Figure 6.8: Distribution of Acreage Awarded till OALP-VIII, by Basin Category

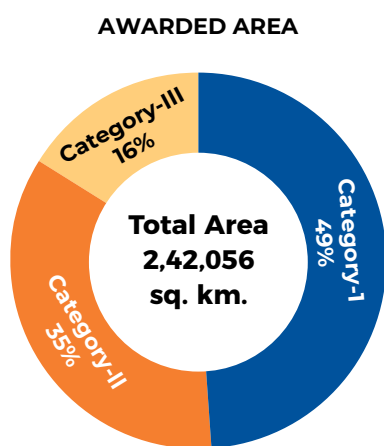


Figure 6.9: Distribution of Acreage Awarded till OALP-VIII, by location type

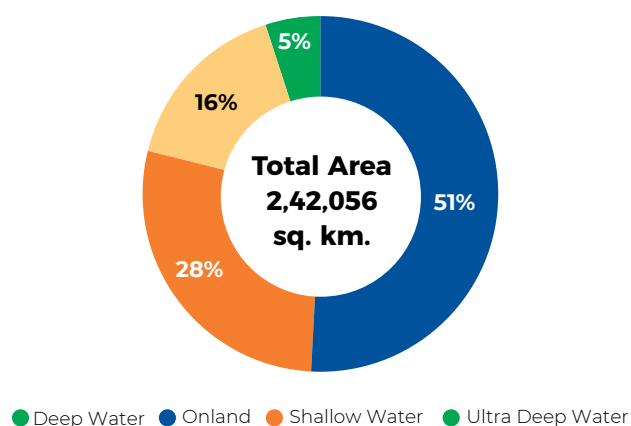


Table 6.12: Basin wise segregation of Awarded Blocks (OALP I to VIII)

Basin	No. of Blocks	Contract Area Awarded
Andaman-Nicobar	4	23262
Assam Arakan Fold Belt	14	6569
Assam Shelf	21	20883
Bengal-Purnea	5	17396
Cambay	24	12277



Basin	No. of Blocks	Contract Area Awarded
Cauvery	8	19609
Cuddapah	1	3306
Ganga-Punjab	3	2428
Himalayan Foreland	1	666
Kerala Konkan	3	11350
Krishna Godavari	9	15335
Kutch	7	10967
Mahanadi	8	28142
Mumbai Offshore	9	23272
Narmada	1	2999
Rajasthan	15	19482
Satpura-South Rewa-Damodar	1	906
Saurashtra	5	9949
Vindhyan	5	13260
Total	144	242056

Bidding Round Completed in FY 2023-24:

OALP Bid Round-VIII:

OALP Bid Round-VIII was launched on 7th July 2022, offering 10 exploration blocks comprising the area of 34,364.53 sq. km spread over 9 Sedimentary Basins. Two (2) blocks are in Onland (area 2,246.15 sq. km), Four (4) blocks are in Shallow Water (area 17,345.99 sq. km), two (2) blocks are in Deep Water (area 3,855.41 sq. km) and Two (2) blocks are in Ultra-deep Water (area 10,916.98 sq. km) areas.

Bid Submission of OALP Round-VIII was closed on 5th July 2023. Total 13 Bids received for 10 Blocks. All The blocks were awarded to respective bidders in month of Dec-2023 and contract signing was held on 03.01.2024. A total of Seven (7) Blocks were awarded to M/s. ONGC (Oil and Natural Gas Corporation) and One (1) Block to M/s. Oil India Limited. The consortium of Reliance Industries (RIL) and BP as well as Sun Petrochemicals awarded a block each.

Further, four (4) blocks covering an area of 7,553.73 sq. km are falling in Category-I, three (3) blocks covering an area of 13,225.58 sq. km in Category-II and three (3) blocks covering an area of 13,585.19 sq. km in Category-III Basins.

Committed Investment in these 10 Blocks is around 233.65 MMSUD.

Committed Exploration Work Programme and Committed Investment (OALP-I to OALP-VIII)

Contractor of the 144 blocks in Eight rounds of OALP have committed 51,725 LKM of 2D Seismic Survey and 66,845 sq. km of 3D Seismic survey, 499 number of Exploratory wells along with 290 core analysis to establish shale resources. The committed investment in these blocks is around 3.37 USD billion. Summary of Committed Work Programme and Investment is as under-



Table 6.13: OALP I to VIII CWP & INVESTMENTS (Operator-Wise)

Operator	No. of Blocks	Committed Work Programme				Investment in MM USD
		2D Seismic (LKM)	3D Seismic (SKM)	Exploratory Wells (No.)	Core Analysis (No.)	
ONGC	52	7580	33229	176	35	1603
Vedanta Limited	51	10620	22971.59	192	190	786
Oil India Limited	30	17510	4088	74	53	742
Sun Petrochemicals Pvt Ltd.	4	8005	2829	37	0	103
RIL-BP	2	8000	2714	6	3	85
GAIL	2	0	292	3	1	10
BPRL	1	0	174	3	1	15
HOEC	1	0	79	2	2	3
IOCL	1	10	469	6	5	24
Total	144	51725	66845	499	290	3371

*The committed 2D & 3D Seismic figures are after swapping.

Monitoring of OALP Blocks

Coordinators have been designated for each Block to monitor the Petroleum Operations in the Blocks. Management Committee Meetings are being conducted regularly in every six (6) months. Management Committee comprising representatives from the Government and the Contractor to closely review and monitor the Exploration activities in the Blocks. Grievances of the Contractors are also resolved during the MC Meetings. Furthermore, other tools to monitor Petroleum Operations are Quarterly Progress Report (QPR), Quarterly Gantt Chart and Review meetings.

Quarterly Progress Report comprises the actual number of Exploration Work Programme completed during the relevant quarter against Committed Work Programme. Operators also provide planned work programme for upcoming quarter and for current Financial Year.

Contractors submit Gantt chart for monitoring overall activities carried out during the relevant

quarter to accomplish Committed Work Programme. It comprises comprehensive list of activities mandatory to complete Exploration Work in the Blocks.

To improve the coordination between DGH and Operators, DGH organized a workshop on "Review of Exploration Work Progress in OALP & NELP Regimes" in September-2023 at DGH. The workshop provided an open platform to discuss Operator's action plan to complete the committed work programme and assess the area which need Government intervention / support. To sensitize the operators about critical RSC provisions, DGH also made a presentation.



Overview of Petroleum Operations in Blocks awarded under OALP

i. Status of grant of Petroleum Exploration Licence (PELs), as of 31st March 2024

Total 177 Petroleum Exploration License (PEL) were involved in 144 blocks awarded in Eight rounds of bid, out of which 156 PELs for an area of 225,978 sq.km have been granted till 31st March 2024. Two numbers of PEL were denied by Union Territory of Puducherry for an area of 40.53 sq. km. Further 10 PEL of an area of 7,136.41 sq. km was not granted by the State Govt. of Tamil Nadu, Andhra Pradesh and Union Territory of Puducherry. This area has been surrendered. 08 PELs for an area of 7450 sq. km. are pending from various State Government while Operator has not applied for PEL in one block with an area of 1200 sq.km. Summary of status of PELs is as under



Table 6.14: Summary Status of PELs on OALP rounds

OALP Bid Round	Total No of PELs	PEL Granted	PEL Pending	PEL Denied
OALP I	76	66	2	8**
OALP II	18	17	1	0
OALP III	21	15	2	4**
OALP IV	7	7	0	0
OALP V	13	13	0	0
OALP VI	24	22	2	0
OALP VII	8	8	0	0
OALP VIII	10	8	2	0
Total	177	156	9	12

*Some of the awarded blocks falls under the jurisdiction of multiple states hence the number of PELs are more than the number of awarded blocks.

** Due to Non-grant of PEL in the State of Tamil Nadu, Puducherry & Andhra Pradesh, the Block/Part Area is surrendered by the Contractor.



Table 6.15: Basin-wise Status of PELs in OALP rounds

Basin	Total No of PELs	PEL Granted	PEL Pending	PEL Denied
Andaman-Nicobar	6	6	0	0
Assam Arakan Fold Belt	17	16	1	0
Assam Shelf	31	29	2	0
Bengal-Purnea	6	5	1	0
Cambay	26	24	2	0
Cauvery	15	6	2	7
Cuddapah	1	1	0	0
Ganga-Punjab	4	4	0	0
Himalayan Foreland	1	1	0	0
Kerala Konkan	3	3	0	0
Krishna Godavari	10	4	1	5
Kutch	9	9	0	0
Mahanadi	10	10	0	0
Mumbai Offshore	9	9	0	0
Narmada	2	2	0	0
Rajasthan	16	16	0	0
Satpura-South Rewa-Damodar	1	1	0	0
Saurashtra	5	5	0	0
Vindhyan	5	5	0	0
Total	177	156	9	12

ii. Actual Exploration Work Programme

As on 31st March 2024, contractors of the blocks have acquired 31,467 LKM of 2D Seismic data and 33,705 Sq. km. of 3D Seismic data of CWP. A total of 52 wells have been drilled till FY 2023-24.

Table 6.16: Exploratory work in OALP Blocks (As on 31st March, 2024)

Basin	2D, LKM	3D, SKM	Wells Drilled
Andaman-Nicobar	8501	2131	
Assam Arakan Fold Belt	1051	150	3
Assam Shelf	3001	496	2
Bengal-Purnea	904	1728	
Cambay	1519	1760	15
Cauvery	0	5709	
Cuddapah	0	221	
Ganga-Punjab	0	597	
Himalayan Foreland	0	0	
Kerala Konkan	0	1028	



Basin	2D, LKM	3D, SKM	Wells Drilled
Krishna Godavari	431	1514	1
Kutch	398	1358	
Mahanadi	2305	3586	5
Mumbai Offshore	940	9248	10
Narmada	0	0	
Rajasthan	10701	870	11
Satpura-South Rewa-Damodar	0	0	
Saurashtra	476	1856	1
Vindhyan	1241	1453	4
Total	31467	33705	52

In FY 2023-24, A total of 1,404 LKM of 2D Seismic data and 6,873 Sq. km. of 3D Seismic data have been acquired and 32 wells have been drilled in different blocks of the OALP.

Discoveries: -

A total of 10 discoveries (6 oil + 4 gas) have been notified under OALP (2 in Rajasthan Basin, 3 in Cambay Basin, 3 in Mumbai Offshore Basin & 2 in Mahanadi Basin). In the FY 2023-24, Five (5) discoveries have been notified by operators. The details of discoveries are given below:

Table 6.17: Details of Discoveries notified in OALP rounds

S.No.	Block	Operator	Discovery Name	Type of Discovery	Offshore / Onland	Basin	Formation	Notification of Discovery (NOD)
1	RJ-ONHP-2017/1	Vedanta	KW-2 UPDIP-1	Oil Discovery	Onland	Rajasthan	Barmer Hill formation	16.12.2020
2	RJ-ONHP-2017/2	Vedanta	Durga-1	Oil Discovery	Onland	Rajasthan	Lower Dharvi Dungar formation/ Eocene	21.02.2022
3	CB-ONHP-2017/2	Vedanta	Jaya-1	Gas Discovery	Onland	Cambay	Hazad/ Mid to late Eocene	23.08.2021
4	CB-ONHP-2017/7	Vedanta	FB-1	Oil Discovery	Onland	Cambay	Older Cambay Shale (OCS) Unit-2	30.05.2022
5	MB-OSHP-2017/1	ONGC	MBS171HAA-A	Gas Discovery	Offshore	Mumbai Basin	Panna/ Sandstone	06.12.2022
6	MB-OSHP-2018/1	ONGC	MBS181HCA-1	Oil Discovery	Offshore	Mumbai Basin	Mahuva Sandstone	16.05.2023
7	MB-OSHP-2018/2	ONGC	MBS182HDA-1	Oil Discovery	Offshore	Mumbai Basin	Bassein Limestone	09.05.2023
8	MN-DWHP-2018/1	ONGC	MDW-27/ UTKAL	Gas Discovery	Offshore	Mahanadi Basin	Pliocene	03.01.2024
9	MN-DWHP-2018/1	ONGC	MDW-26	Gas Discovery	Offshore	Mahanadi Basin	Pliocene	15.01.2024
10	CB-ONHP-2021/2	ONGC	West Amod#1	Oil Discovery	Onland	Cambay	Hazad / Mid Eocene	07.03.2024



FDP Submission:

Operator (M/s. Vedanta) has submitted the Field Development Plan (FDP) for discovery Jaya-1 in Block CB-O NHP-2017 in time span of less than three (3) years. FDP was approved and development activities already commenced in the Block.



Investment Opportunity:

OALP Bid Round-IX

Government of India has launched OALP Bid Round-IX on 03rd January 2024 offering 28 Blocks with an area of around 1,36,000 sq.km for Exploration and Development through International Competitive Bidding. Out of 28 Blocks, 23 Blocks are carved out based on the EoIs received during different EoI Windows and five (5) are DGH carved out Blocks.

These 28 Blocks are spread over eight (8) Sedimentary Basins where 16 Blocks fall under Category-I Basins and 12 Blocks are fall under Category-II Basins.

OALP Round-IX is mainly focused on Deep / Ultra Deep-water exploration where Out of total Area offered, Ultra-Deep-Water blocks covers an area of 96,073 Sq. km in 11 Blocks which account of more than 70% of total area. Remaining Nine (9) Blocks with an area of 13875 Sq.km are in Onland and Eight (8) Blocks with an area of around 26648 are in Shallow Water. The bid closing date of Round-IX is 31.08.2024.





Launch of OALP Round-IX

Table 6.18: The Blocks on offer under OALP Round IX

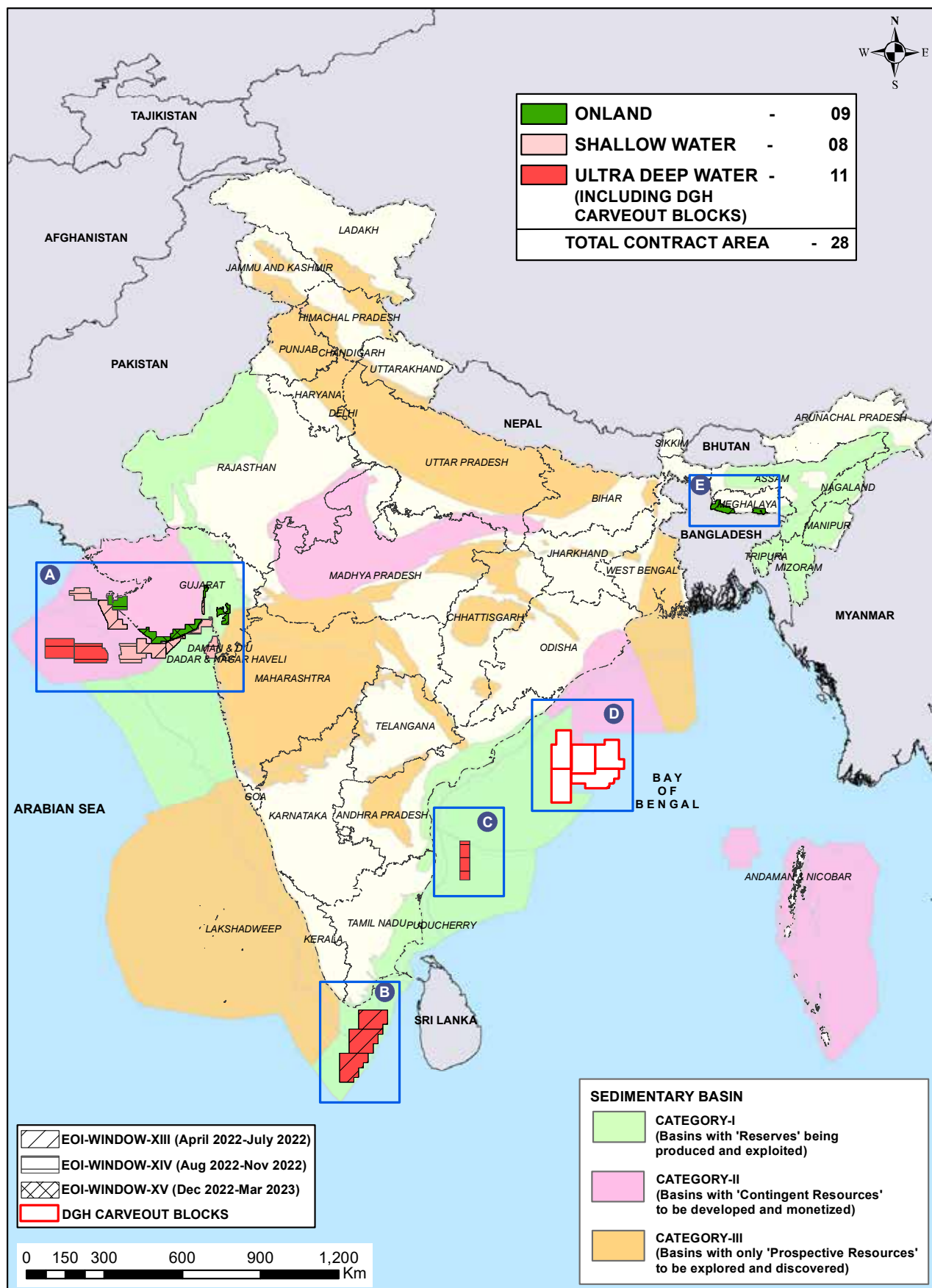
S. No.	BASIN NAME	BASIN CATEGORY	BLOCK NAME	MAP REF	APPROX. ADMIS SIBLE AREA (Sq. Km.)	TARGET DEPTH FOR WELLS TO BE DRILLED (m)*	MINIMUM NET WORTH REQUIREMENT (MMUSD)	REQUISITE BID BOND (USD)
				No.				
ONLAND BLOCKS, 9 Blocks (13875 Sq.km)								
1	CAMBAY	I	CB-ONHP-2022/2	ON1	713.92	1000	6.24	44,800
2	CAMBAY	I	CB-ONHP-2023/1	ON2	446.27	1500	5.41	28,200
3	CAMBAY	I	CB-ONHP-2023/2	ON3	636.23	3150	6	40,000
4	CAMBAY	I	CB-ONHP-2023/3	ON4	416.44	1400	5.31	26,200
5	ASSAM SHELF	I	AS-ONHP-2022/2	ON5	784.32	1600	6.53	50,600
6	ASSAM SHELF	I	AS-ONHP-2022/3	ON6	2168.09	1000	10.98	1,39,600
7	SAURASHTRA	II	GS-ONHP-2023/1	ON7	2939.56	Not Biddable	13.26	1,85,200
8	SAURASHTRA	II	GS-ONHP-2023/2	ON8	2977.28	Not Biddable	13.32	1,86,400



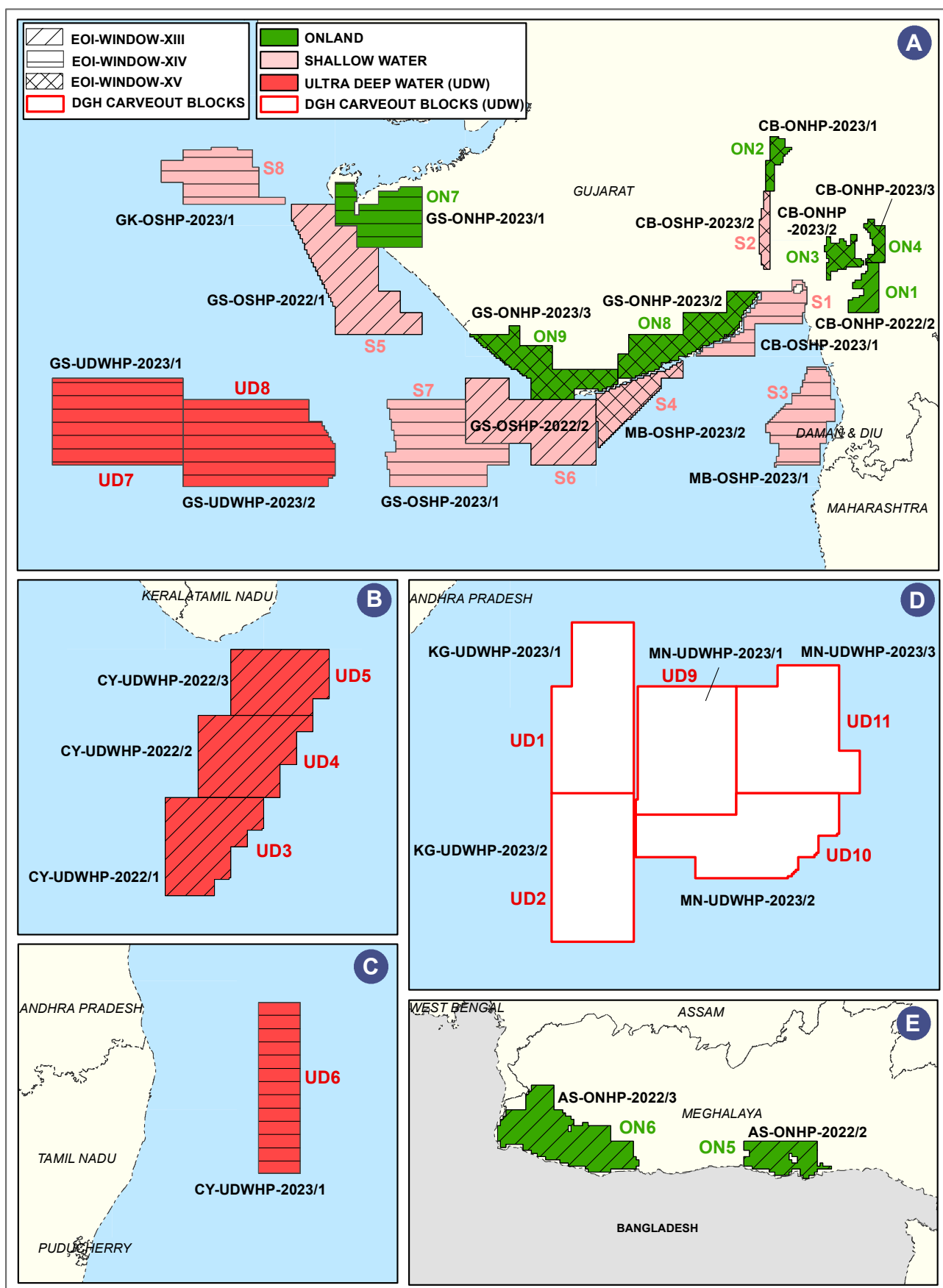
S. No.	BASIN NAME	BASIN CATEGORY	BLOCK NAME	MAP REF	APPROX. ADMIS SIBLE AREA (Sq. Km.)	TARGET DEPTH FOR WELLS TO BE DRILLED (m)*	MINIMUM NET WORTH REQUIREMENT (MMUSD)	REQUISITE BID BOND (USD)
				No.				
9	SAURASHTRA	II	GS-ONHP-2023/3	ON9	2793.08	Not Biddable	12.73	1,74,600
SHALLOW WATER BLOCK, 8 Blocks (26648 sq.km)								
10	CAMBAY	I	CB-OSHP-2023/1	S1	1873.66	800	29.74	1,17,400
11	CAMBAY	I	CB-OSHP-2023/2	S2	476.58	1500	21	30,000
12	MUMBAI OFFSHORE	I	MB-OSHP-2023/1	S3	2935.19	1500	36.3	1,83,000
13	MUMBAI OFFSHORE	I	MB-OSHP-2023/2	S4	1749.74	1500	28.92	109,200
14	SAURASHTRA	II	GS-OSHP-2022/1	S5	5585.61	Not Biddable	53.08	2,00,000
15	SAURASHTRA	II	GS-OSHP-2022/2	S6	5453.96	Not Biddable	52	2,00,000
16	SAURASHTRA	II	GS-OSHP-2023/1	S7	5408.79	Not Biddable	51.68	2,00,000
17	KUTCH	II	GK-OSHP-2023/1	S8	3164.61	Not Biddable	37.98	1,99,800
ULTRA DEEP-WATER BLOCK, 11 Blocks (96073 sq.km)								
18	KRISHNA-GODAVARI	I	KG-UDWHP-2023/1	UD1	9495.16	4500	174.00	200,000
19	KRISHNA-GODAVARI	I	KG-UDWHP-2023/2	UD2	9223.22	4500	171.00	200,000
20	CAUVERY	I	CY-UDWHP-2022/1	UD3	9514.63	800	170.94	2,00,000
21	CAUVERY	I	CY-UDWHP-2022/2	UD4	9844.72	1300	174	2,00,000
22	CAUVERY	I	CY-UDWHP-2022/3	UD5	7795.45	1700	156	2,00,000
23	CAUVERY	I	CY-UDWHP-2023/1	UD6	5330.49	2100	135	2,00,000
24	SAURASHTRA	II	GS-UDWHP-2023/1	UD7	7699	Not Biddable	159	2,00,000
25	SAURASHTRA	II	GS-UDWHP-2023/2	UD8	8446.28	Not Biddable	165.9	2,00,000
26	MAHANADI	II	MN-UDWHP-2023/1	UD9	9466.85	Not Biddable	173.61	2,00,000
27	MAHANADI	II	MN-UDWHP-2023/2	UD10	9425.84	Not Biddable	172.95	2,00,000
28	MAHANADI	II	MN-UDWHP-2023/3	UD11	9831.48	Not Biddable	177.00	2,00,000



BLOCKS ON OFFER UNDER HELP, OPEN ACREAGE LICENSING PROGRAMME BID ROUND-IX



MAP OF BLOCKS ON OFFER UNDER HELP (OALP BID ROUND - IX)





7

Unconventional Petroleum Resources



Unconventional energy resources refer to sources of energy that are extracted and produced using methods that differ from traditional fossil fuel extraction.

1. Introduction:

Unconventional energy resources refer to sources of energy that are extracted and produced using methods that differ from traditional fossil fuel extraction. Unconventional resources exist in petroleum accumulations that are pervasive throughout a large area and are not significantly affected by hydrodynamic influences (also called “continuous-type deposit”). These resources have inherent development risks, hence more challenging to develop compared to conventional resources. Key unconventional energy resources include:

1.1 Coal Bed Methane (CBM):

During the process of coalification or thermal maturation of coal beds, valuable quantities of hydrocarbon gas get accumulated, primarily in the adsorbed state. CBM is considered a cleaner energy source compared to coal, as its combustion produces less carbon dioxide and



other pollutants. It is extracted by reducing the pressure within the coal seams through water pumping, which releases the adsorbed methane gas.

There are four types of terms used to describe the methane emanating from coal beds:

- a. **Coalbed Methane (CBM) or Coal Seam Gas (CSG)** - A generic term for the methane-rich gas occurring naturally in coal seams typically comprising 80% to 90% methane with lower proportions of ethane, propane, nitrogen, and carbon dioxide. This refers to the methane recovered from unmined coal seams using surface boreholes.
- b. **Coal Mine Methane (CMM)** - Methane gas captured at working mine by underground methane drainage techniques. This includes gas captured underground, whether drained in advance or after mining, and any gas drained from the surface of well.
- c. **Ventilation Air Methane (VAM)** - Methane emitted from coal seams that enters the ventilation air and are exhausted from the ventilation shaft at a low concentration, typically in the range of 0.1% to 1.0% by volume.
- d. **Abandoned Mine Methane (AMM)** - The methane gas recovered from abandoned coal mines.

1.2 Shale Gas and Shale Oil:

Gas or oil within shales are the un-expelled part during petroleum generation process and found trapped within the pore space of shale as the source rock. Genetically, shales have no intrinsic permeability for self-flow to a well bore.

Like all other unconventional resources of continuous nature, shale plays too have less geological risks than conventional but more development risks.

Shale gas and oil have significantly increased global energy supplies and have transformed the energy landscape in countries like the USA. The commercial extraction of shale gas and oil involves the use of horizontal drilling followed

by hydraulic fracturing (fracking). These techniques open up more reservoir contact and create sufficient fracture conductivity to release the trapped gas and oil.

1.3 Tight Gas:

Tight gas refers to natural gas trapped in low-permeability rocks other than shales, viz. sandstones, siltstones or carbonates. Like shale gas, tight gas extraction requires hydraulic fracturing to create flow conduits. Tight gas is genetically conventional deposits, however due to location in the deeper part of the basins, it loses intra-granular porosity due to excessive over-burden pressure. For the same reasons, such deposits are often developed into high pressure and high temperature conditions making gas extraction more challenging.

1.4 Gas Hydrates:

Gas hydrates are crystalline ice-like structures that contain methane and other gases. They are found in deep ocean several hundreds meter below seabed and also in permafrost regions. It is formed under moderately high pressure but low temperature conditions.

Extraction is still experimental, involving methods like depressurization, thermal stimulation, and inhibitor injection to dissociate the hydrate. Gas hydrates hold vast amount of natural gas as 1-unit hydrate volume expands into ~160 unit gas to surface and represent a potential future energy source.

1.5 Oil shales:

Oil shales consist of a mixture of shales, sands, water, clay, and bitumen, a heavy viscous form of crude oil. It is genetically immature source rocks formed due to failed process of petroleum generation.

Oil is extracted by surface mining and in-situ techniques, such as steam-assisted gravity drainage. Oil shales are a significant source of heavy oil, but their development raises environmental concerns due to greenhouse gas emissions and land disturbance.



2. Unconventional hydrocarbons for energy security and economic growth

2.1 Energy Security

India is in energy transition towards a gas-based economy, aiming to increase the share of natural gas to 15% in its energy mix by 2030. In this context, the contribution of unconventional

hydrocarbons is crucial to achieving this goal.

Coal Bed Methane (CBM):

India has established CBM in-place with commercially producing deposits.

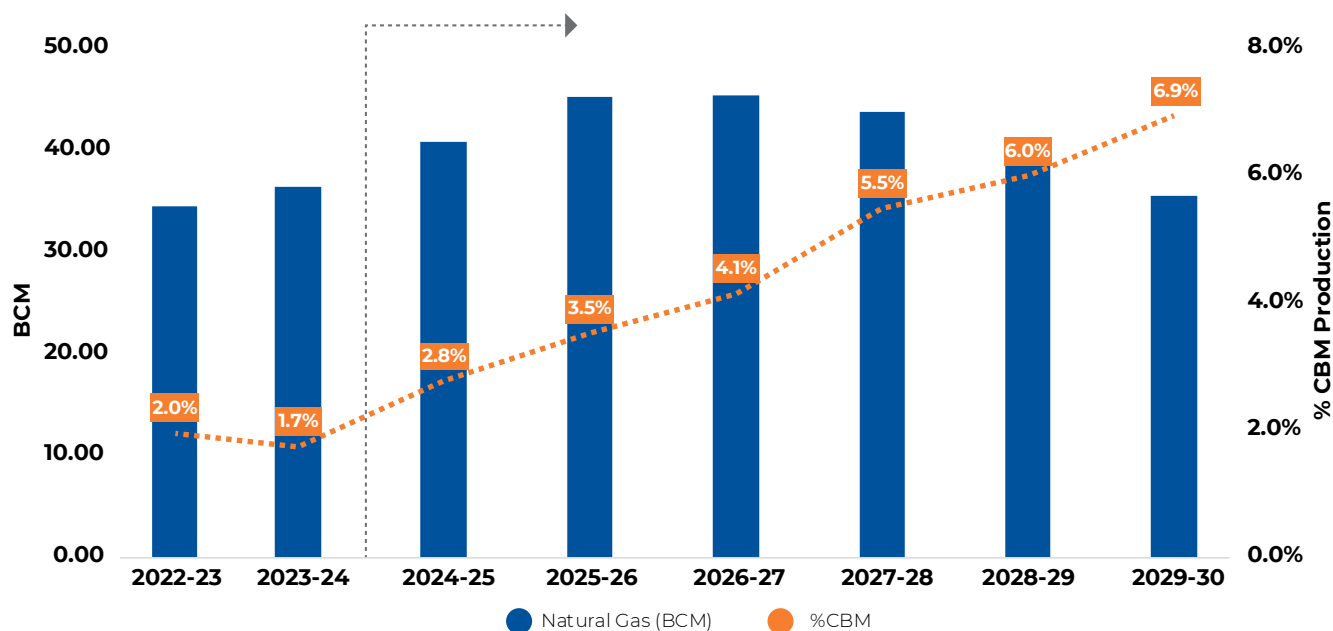
The development of these resources can substantially augment domestic gas supplies.

Table 7.1: State wise distribution of CBM Resources in India

Sl. No.	STATE	Total GIIP (BCM)	Total GIIP (TCF)	Discovered (TCF)
1	Jharkhand	722.08	25.5	1.99
2	Rajasthan	359.62	12.7	0
3	Gujarat	351.13	12.4	0
4	Odisha	243.52	8.6	0
5	Chhattisgarh	240.69	8.5	0
6	Madhya Pradesh	218.04	7.7	3.64
7	West Bengal	218.04	7.7	4.85
8	Tamil Nadu	104.77	3.7	0
9	Telangana & Andhra Pradesh	99.11	3.5	0
10	Maharashtra	33.98	1.2	0
11	Northeast	8.50	0.3	0
Total		2,599.48	91.8	10.48

Note: GIIP: Gas Initially In-place, Conversion factor: 1 cubic meter = 35.3147 cubic feet



Figure 7.1: CBM Contribution in India's Natural Gas Projection

CBM production share in domestic natural gas is envisaged to be up from 2% to 7% by 2030.

By tapping into its CBM resources, India can ensure a more stable and secure supply of natural gas, which is critical for power generation, industrial use, and residential consumption.

Shale Gas and Shale Oil:

A preliminary assessment of shale gas/oil in India was conducted by three agencies.

1. In 2011, the United States Geological Survey (USGS) estimated the technically recoverable shale gas as 6.1 TCF for 3 basins namely Cambay, Krishna-Godavari (KG) and Cauvery. Later in 2014, the agency estimated a technically recoverable shale oil as 62 million barrels for Cambay Basin alone.
2. In 2013, the National Oil Company(NOC), ONGC estimated shale gas in-place of 187.5 TCF from 5 sedimentary basins namely Cambay, KG, Cauvery, Ganga and Assam.
3. Central Mine Planning and Design Institute (CMPDI), in July 2013 had estimated 45.8 TCF in the basins with Gondwana shales.

It has been envisaged that shale gas and oil exploration in basins/sub-basins like Cambay, Krishna-Godavari (KG) and Damodar Valley can significantly help meet the growing energy demand.

Gas Hydrates:

Gas hydrate deposits, located in the KG and Mahanadi offshore represent a significant untapped energy resource. Although commercial production is still in the research phase, gas hydrates could provide a substantial boost to India's future energy security.

2.2 Economic Growth

The development of unconventional hydrocarbons contributes to economic growth through job creation, infrastructure development, and revenue generation.

CBM sector alone has generated significant employment in the states of Madhya Pradesh, Jharkhand and West Bengal. As of 31.03.2024, USD 2.5 billion has been invested for exploration, development, and production activities in eight operational CBM blocks. CBM production contributed USD 127 million as Royalty to State Governments and USD 6.5 million to the Central Government.



3. Status of Unconventional Hydrocarbons

3.1 Coal bed Methane

3.1.1 Governing Policies:

1. In 1997, the Government of India (GoI) formulated a policy for the development of CBM. A Memorandum of Understanding (MoU) was signed between the Ministry of Coal (MoC) and the Ministry of Petroleum and Natural Gas (MoPNG) to work on mutually agreeable framework. According to the policy, MoPNG was designated as the administrative ministry, while DGH appointed as the nodal agency for CBM exploration and development in India.
2. In 2007, CBM Phases & Extensions Policy was framed to provide a transparent and consistent framework for granting extension in exploration phases under CBM contracts.
3. In 2015 (re-notified in 2018), the Government of India, granted permission to Coal India Limited (CIL) and its subsidiaries to explore and produce CBM from its areas under Coal Mining Lease, thereby, dispensing the requirement of having additional License from Ministry of Petroleum and Natural Gas. This was formulated to increase the area under CBM exploration and to accelerate CBM production from coal mining areas.
4. In 2016, unified licensing policy under Hydrocarbon Exploration and Licensing Policy (HELP) was introduced wherein all types of hydrocarbon resources, both conventional and unconventional were allowed to be explored and exploited. The Open Acreage Licensing Programme (OALP) under HELP to carry out exploration and production in open areas, not held by any party and Discovered Small Field (DSF) Policy to exploit oil and gas discoveries, hitherto unpursued are two such policies.
5. In 2017, a policy framework for Early Monetization of CBM was introduced to develop alternate sources of natural gas.

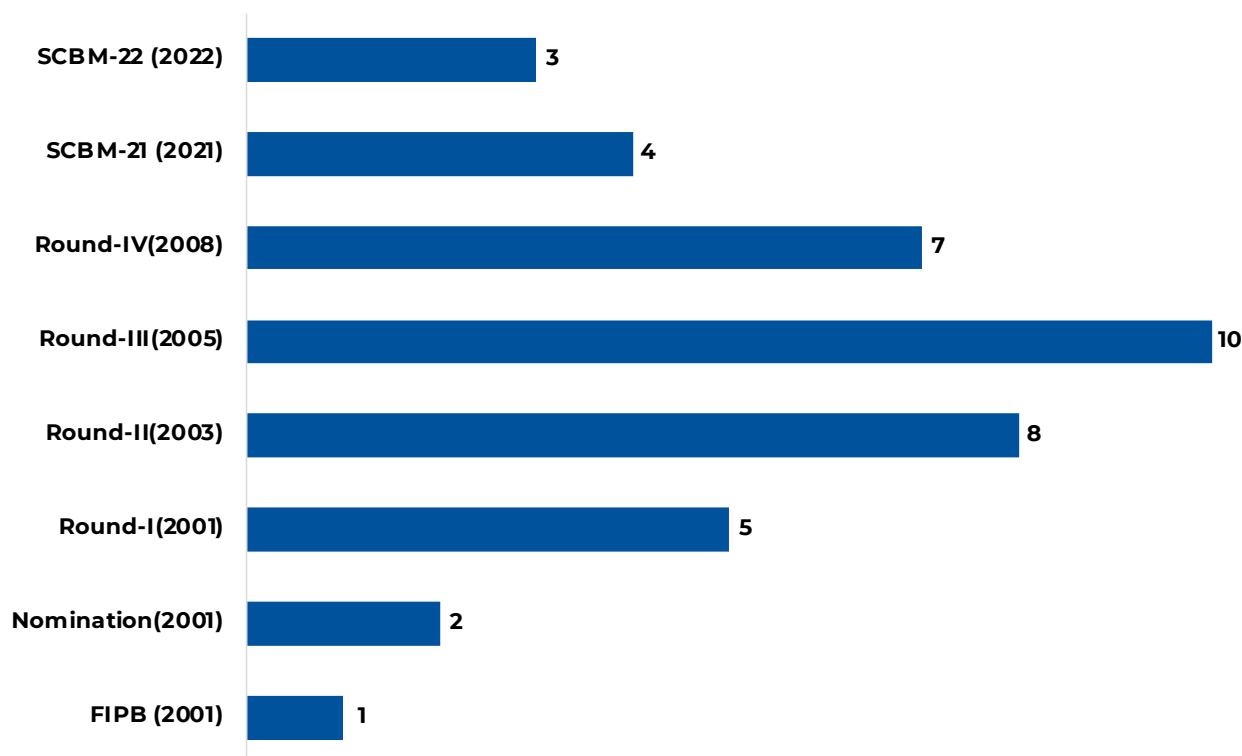
This policy was formulated to provide marketing and pricing freedom for CBM and streamline the operational issues in the existing blocks.

6. In 2018, the Government of India notified a policy framework for Exploration and Exploitation of unconventional hydrocarbons in the existing acreages under existing Production Sharing Contracts (PSC), Coal Bed Methane (CBM) Contracts and Nomination fields.

3.1.2 Award of CBM acreages

1. As per extant CBM policy 1997, the Ministry of Coal, through CMPDI conducted studies to identify prospective CBM areas within the coal-bearing regions of the country. From 2001 to 2008, four CBM bidding rounds were held, resulting in the award of 30 CBM blocks. Additionally, 2 blocks were allocated on a nomination basis, and 1 block was awarded under the Foreign Investment Promotion Board (FIPB) in 2001. During this period (2001-2008), a total area of 16,598 sq km was awarded for CBM exploration and production. These awarded blocks were located across various states including Andhra Pradesh, Assam, Chhattisgarh, Gujarat, Jharkhand, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tamil Nadu, and West Bengal.
2. The total estimated GIIP for the 33 awarded CBM blocks is 62 TCF, of which 10.5 TCF has been established as discovered GIIP.
3. Further, in pursuit of the goal of energy security and to increase the gas share in the country's energy mix, GoI launched Special CBM bid rounds (SCBM) in 2021 and 2022. With attractive fiscal and administrative terms bidding was made under OALP through International Competitive Bidding. During these two SCBM rounds, 7 blocks of area 4,579 sq. km were awarded. The total GIIP of the 7 awarded blocks works out to 294 BCM.



Figure 7.2: Awarded CBM Blocks

3.1.3 Status of the awarded CBM blocks

1. The first commercial production from the CBM blocks commenced in the year 2007 from the Raniganj South block operated by M/s. Great Eastern Energy Corporation Limited (GEECL). Thereafter, 3 more CBM blocks, Raniganj(East), operated by M/s. Essar Oil & Gas Exploration & Production Limited (EOGEPL), Sohagpur(West) operated by M/s. Reliance Industries Limited(RIL) and Bokaro operated by M/s. Oil and Natural Gas Limited(ONGC) started its commercial production in 2016, 2017 and 2019 respectively. Additionally, incidental CBM gas is produced during the testing of CBM wells in Jharia block operated by ONGC.
2. At present, the active acreage for CBM exploration and production is 7,010 sq km and 15 CBM blocks are in operation. Of these, 7 are under exploration, 3 under development and 5 under production stage.
3. The cumulative CBM production as of 31.03.2024 is 6.4 BCM.



Table 7.2: Key statistics of CBM operation in India of CBM resources in India

As of 31.03.2024	
Total CBM rounds completed	6
No. of CBM Blocks awarded in 6 rounds	40
Area covered under 40 blocks	21,177 Sq. Km
Estimated CBM Resource in Country	2,600 BCM (91.8 TCF)
CBM Resources (from 33 Blocks)	1,767.06 BCM (62.4 TCF)
Established CBM Reserves (GIP) (8 CBM Blocks)	342 BCM (12.10 TCF)
Present Area for CBM Operations (15 Blocks)	7,009 Sq. Km
Commercial Production commenced	Jul-07
Total No. of Development Wells drilled	1,137
Avg. Gas Production (FY 2023-24)	1.83 MMSCMD
No. of CBM Blocks in Development/Production Phase	8
No. of CBM Blocks in Exploration	7
No. of CBM Blocks Under Relinquishment	12
No. of CBM Blocks Relinquished	12
No. of blocks under Arbitration	1
Annual CBM Production in FY 2023-24	650 MMSCM
Cumulative Production up to FY 2023-24	6.4 BCM

Table 7.3 : Details of awarded CBM blocks

No.	Block	State	Present Area (SKM)	Contractor (PI%)	Contract signed on	Present Status
CBM BLOCKS OFFERED ON NOMINATION/FIPB ROUTE						
1	Raniganj (South)	West Bengal	210	GEECL (100)	31.05.2001	Production
2	Raniganj (North)	West Bengal	311.8	ONGC (74)-CIL (26)	06.02.2003	Development
3	Jharia	Jharkhand	67.1	ONGC (74)-CIL (26)	06.02.2003	Development/ Incidental production
CBM ROUND-I						
4	RG(East)-CBM-2001/I	West Bengal	500	EOGEPL (100)	26.07.2002	Production
5	SP(East)-CBM-2001/I	Madhya Pradesh	495	RIL (100)	26.07.2002	Development
6	SP(West)-CBM-2001/I	Madhya Pradesh	500	RIL (100)	26.07.2002	Production



No.	Block	State	Present Area (SKM)	Contractor (PI%)	Contract signed on	Present Status
7	BK-CBM-2001/I	Jharkhand	75	ONGC (80)-IOC (20)	26.07.2002	Production
8	NK-CBM-2001/I	Jharkhand	271.5	ONGC (55)-IOC (20)-PEPL (25)	26.07.2002	Development
CBM ROUND-II						
9	SH(N)-CBM-2003/II	Chhattisgarh	825	RIL (100)	06.02.2004	Relinquished
10	BS (1)-CBM-2003/II	Rajasthan	1,045	RIL (100)	06.02.2004	Under relinquishment
11	BS (2)-CBM-2003/II	Rajasthan	1,020	RIL (100)	06.02.2004	Under relinquishment
12	SK-CBM-2003/II	Jharkhand	70	ONGC (100)	06.02.2004	Under Relinquishment
13	NK(W)-CBM-2003/II	Jharkhand	267	ONGC (100)	06.02.2004	Relinquished
14	ST-CBM-2003/II	Madhya Pradesh	714	ONGC (100)	06.02.2004	Relinquished
15	WD-CBM-2003/II	Maharashtra	503	ONGC (100)	06.02.2004	Relinquished
16	BS (3)-CBM-2003/II	Gujrat	790	ONGC (70)-GSPC (30)	06.02.2004	Relinquished
CBM ROUND-III						
17	SP(N)-CBM-2005/III	Madhya Pradesh	609	R-Infra (55)-RNRL (45)	07.11.2006	Under Relinquishment
18	SR-CBM-2005/III	Madhya Pradesh	330	DIL (90)-Coal Gas (10)	07.11.2006	Under Relinquishment
19	RM-CBM-2005/III	Jharkhand	469	Dart Energy (35)-GAIL (35)-EIG (15)-TATA Power (15)	07.11.2006	Under Relinquishment
20	GV(N)-CBM-2005/III	Telangana	386	Coal Gas (10)-DIL (40)-Adinath (50)	07.11.2006	Relinquished
21	BB-CBM-2005/III	West Bengal	248	British Petroleum (100)	16.11.2006	Relinquished
22	MR-CBM-2005/III	Chhattisgarh	634	Dart Energy (35)-GAIL (35)-EIG (15)-TATA Power (15)	07.11.2006	Under relinquishment
23	TR-CBM-2005/III	Chhattisgarh	458	Dart Energy (35)-GAIL (35)-EIG (15)-TATA Power (15)	07.11.2006	Under relinquishment
24	BS (4)-CBM-2005/III	Rajasthan	1,168	REL (45)-RNRL (45)-Geopetrol (10)	07.11.2006	Under Relinquishment
25	BS (5)-CBM-2005/III	Rajasthan	739	REL (45)-RNRL (45)-Geopetrol (10)	07.11.2006	Under Relinquishment

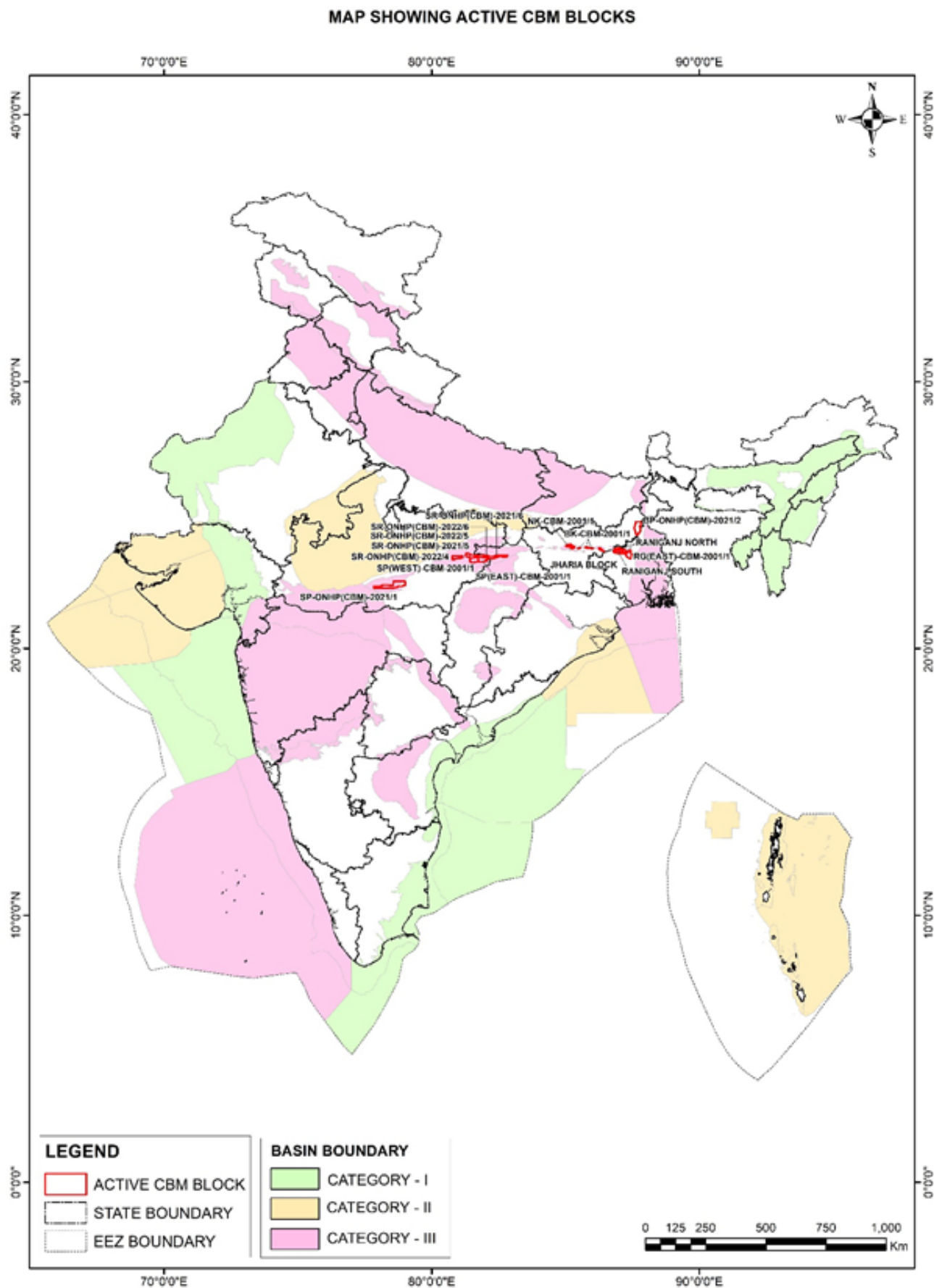


No.	Block	State	Present Area (SKM)	Contractor (PI%)	Contract signed on	Present Status
26	KG (E)-CBM-2005/III	Andhra Pradesh	735	REL (45) – RNRL (45) – Geopetrol (10)	07.11.2006	Relinquished
CBM ROUND-IV						
27	AS-CBM-2008/IV	Assam	113	Dart Energy (10)-OIL (90)	29.07.2010	Under Relinquishment
28	MG-CBM-2008/IV	Tamil Nadu	667	GEECL (100)	29.07.2010	Under Arbitration
29	RM(E)-CBM-2008/IV	Jharkhand	1,128	EOGEPL (100)	29.07.2010	Under Relinquishment
30	TL-CBM-2008/IV	Odisha	557	EOGEPL (100)	29.07.2010	Relinquished
31	IB-CBM-2008/IV	Odisha	209	EOGEPL (100)	29.07.2010	Relinquished
32	SP(NE)-CBM-2008/IV	Madhya Pradesh & Chhattisgarh	339	EOGEPL (100)	29.07.2010	Under Relinquishment
33	ST-CBM-2008/IV	Madhya Pradesh	714	Dart Energy (80)-TATA Power (20)	29.07.2010	Relinquished
SPECIAL CBM BID ROUND-2021						
34	BP-ONHP(CBM)-2021/2	Jharkhand	991	ONGC	09.09.2022	PEL Awaited
35	SP-ONHP(CBM)-2021/1	Madhya Pradesh	1,771.5	Invenire Petrodyne	09.09.2022	PEL Granted
36	SR-ONHP(CBM)-2021/5	Madhya Pradesh	515	ONGC	09.09.2022	PEL Granted
37	SR-ONHP(CBM)-2021/6	Chhattisgarh	584	Vedanta	09.09.2022	PEL Granted
SPECIAL CBM BID ROUND-2022						
38	SR-ONHP(CBM)-2022/4	Madhya Pradesh	418	Transcontinental Natural Resources Ltd	03.01.2024	PEL Awaited
39	SR-ONHP(CBM)-2022/5	Madhya Pradesh	211	Transcontinental Natural Resources Ltd	03.01.2024	PEL Awaited
40	SR-ONHP(CBM)-2022/6	Chhattisgarh	88	Oilmax Energy Private Ltd.	03.01.2024	PEL Awaited

*PEL- Petroleum Exploration License, granted by respective State Governments



Figure 7.3: The geographical distribution of operational/active CBM blocks



3.1.4 CBM production over the years

At present, out of 15 active/operational CBM Blocks, 8 CBM blocks are under production & development. The table below presents historical data on production and development wells drilled across the eight blocks.

Table 7.4 : CBM GIIP, Reserves, Production and Development wells

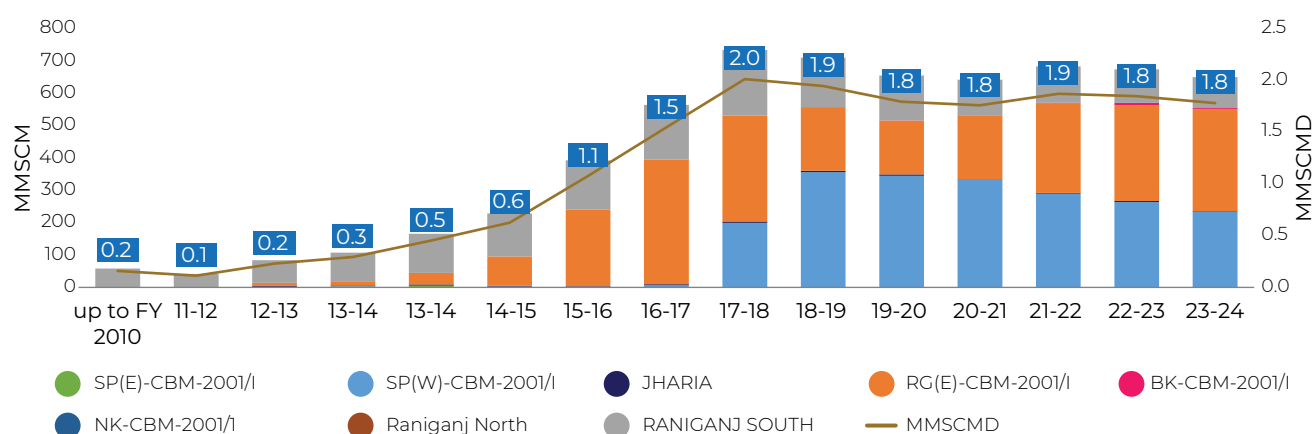
Sl. No.	Block Name	Put on Production	GIIP	GIIP	Rec. Reserves (BCM)	Rec. Reserves (TCF)	Cum. Production Up to FY 23-24	Cum. Production	Development Wells
			(BCM)	(TCF)			(MMSCM)	(BCF)	
1	RG(E)-CBM-2001/I	Jul-2016	106.84	3.77	22.12	0.78	2549.20	89.98	429
2	SP(W)-CBM-2001/I	Mar-2017	55.50	1.96	15.43	0.54	2035.50	71.85	327
3	BK-CBM-2001/I	Aug-2019	25.76	0.91	2.62	0.09	13.30	0.47	99
4	RANIGANJ (SOUTH)	Jul-2007	74.19	2.62	11.88	0.42	1749.80	61.76	156
5	SP(E)-CBM-2001/I	-	47.86	1.69	10.11	0.36	8.20	0.29	37
6	JHARIA*	Jan-2012	11.95	0.42	0.76	0.03	37.50	1.32	27
7	RANIGANJ (NORTH)	-	4.88	0.17		0.00	-	-	0
8	NK-CBM-2001/I	-	15.69	0.55	0.79	0.03	-	-	62
Total			342.66	12.10	63.70	2.25	6393.50	225.68	1137

*Jharia on test production since 2012.



Table 7.5 : Year-on-year CBM production

Sl. No.	Block Name	Production (MMSCM)														
		Till FY 2010	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24
1	SP(W)-CBM-2001/I	0	0	1.1	1.2	1.1	1.5	1.4	6.4	199.8	356.7	344.9	333.7	290.1	263.9	233.8
2	RG(E)-CBM-2001/I	0	0	9.1	12.8	35.4	91.3	236.5	385.5	328.4	197.7	166.9	197.1	277	296.3	315.1
3	RANIGANJ SOUTH	58.2	41.4	70	88	121.1	132.4	152.9	169.6	202.6	152.6	138.9	109.9	112.3	104.0	95.8
4	BK-CBM-2001/I	0	0	0	0	0	0	0	0	0	0	0.2	0.6	1.6	7.0	3.9
5	JHARIA	0	0	3.6	2.9	3.4	2.5	2	3.1	4	3.6	4.4	1.1	2.4	3.1	1.5
6	SP(E)-CBM-2001/I	0	0	0.4	2.2	4.5	0.6	0	0.1	0	0	0	0	0	0.0	0.4
7	NK-CBM-2001/I	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
8	Raniganj North	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
Yearly total		58.2	41.4	84.2	107.2	165.5	228.2	392.9	564.6	734.8	710.5	655.4	642.4	683.4	674.4	650.4
Cumulative		58.2	99.6	183.8	291	456.5	684.7	1077.6	1642.2	2377	3087.5	3742.9	4385.3	5068.7	5743.1	6393.5

Figure 7.4: Annual CBM production

3.1.5 Case Studies: Insights into key projects

A. **RG (East)-CBM-2001/1:** The CBM Block RG(East)-CBM-2001/1, covering an area of approximately 500 Sq.km, was awarded to M/s Essar Oil Ltd in 2002. The block is under production since July 2016. Some of key highlights of the CBM project in RG(East) are:

- Drilling of more than 400 development wells.
- Current production rate is 0.9 MMSCMD.
- Implementation of technological advancements as under:

a. **Advanced Chemical Stimulation:**

To clear coal fines from the zones to eliminate potential well failure issues like rotor locking, techniques like Surfactant Flushing & Verde Chem trials are under trial. These may help in clearing the near-wellbore damage and further enhancing water mobility and gas production.

b. **Microbial techniques to enhance oil recovery by breaking down organic materials:**

This technique facilitates the microbial communities involved in the dynamic process of methanogenesis to further increase the methane production from the biodegradation of coal over timescales.

c. **Use of HVFR (High Viscosity Friction Reducer):** It is used as it has very less residue as compared to Guar-based

linear gel to increase frac half-length.

d. **Drilling of horizontal wells:** Planned to drill Horizontal wells in deeper, tight CBM reservoirs to open up greater reservoir contact area.

- Extensive data acquisition programme is underway in the deeper area to identify opportunities in deeper CBM to open-up newer areas of development.
- The exploration of shale gas is also at the planning stage.

B. SP (West)-CBM-2001/1

The CBM Block SP(West)-CBM-2001/1, covering an area of approximately 500 Sq.km, was awarded to M/s Reliance Industries Ltd in 2002. The block is under production since March 2017. Some of key highlights of the CBM project in SP(West) are:

- Drilling of more than 300 development wells.
- Current production rate is 0.7 MMSCMD.
- To ramp up production from block, M/s RIL has initiated 40 multi-lateral horizontal well program and so far, drilled 17 wells, out of which 4 are bilateral, 11 are trilateral and 2 are quadrilateral wells. The longest individual lateral achieved is 1,222m and the highest cumulative lateral length in a well (quadrilateral well) is 3,568m. From the 15 wells connected, the CBM production has jumped to 0.2 MMSCMD.



3.1.6 Future opportunities:

1. GoI is working on **Exploration Plans** in pursuit of establishing CBM resource in unexplored coal bearing areas. Additionally, GoI is looking into alternatives for CBM potential like analysis in abandoned or de-coaled mines, which are rendered unsuitable for coal mining.
2. **Coal India** and its subsidiaries are actively looking for coal bearing areas under their leasehold to award for CBM exploration and production. As per GoI Policy 2018, wherein CIL and its subsidiaries were granted CBM rights in their leasehold areas, Bharat Coking Coal Limited (BCCL), a subsidiary of Coal India Limited has awarded one CBM blocks (area 24 sq. km) in Jharia, Jharkhand for CBM exploration and production.
3. The **competitive gas price** along with enhanced **natural gas pipeline network** across the country has significantly enhanced the natural gas demand.
4. The projection of CBM production up to FY29-30 is shown in below table. This consists of production from existing 8 operational blocks. The recently awarded blocks (7) may also add up production in coming years.

Table 7.6 : CBM Production Projection

SI No	Block	Projection (MMSCM)					
		24-25	25-26	26-27	27-28	28-29	29-30
1	SOHAGPUR WEST	384	397	337	300	275	256
2	RANIGANJ EAST	462	934	1303	1586	1727	1756
3	RANIGANJ SOUTH	133	191	264	270	285	290
4	Bokaro	64	105	132	316	313	297
5	JHARIA	7	63	121	118	116	114
6	SOHAGPUR EAST	0	0	4	65	146	226
7	NK-CBM-2001/1	15	27	157	197	196	195
8	Raniganj North	0	0	74	126	118	110
Annual Production (MMSCM)		1,065	1,717	2,392	2,978	3,176	3,244
Average Rate (MMSCMD)		2.9	4.7	6.6	8.2	8.7	8.9

3.2 Shale gas

3.2.1 Governing Policies:

1. In order to understand the prospectivity and untap the shale gas and oil resource potential in India, GoI announced a Shale gas and Oil exploration policy on 14.10.2013 for the National Oil Companies (NOCs), namely ONGC, and OIL. The companies were required to carry out exploration in their PML areas.
2. In 2018, the GoI notified a Policy framework for Exploration and Exploitation of unconventional hydrocarbons in existing acreages under existing Production Sharing Contracts (PSC), Coal Bed Methane (CBM) Contracts and Nomination fields.
3. In October 2018, a policy framework to promote and incentivize Enhanced Recovery Methods for Oil and Gas was notified by the Ministry of Petroleum and Natural Gas, Government of India. Under



this policy, fiscal incentives are provided from the first day of the entire production from future discoveries of unconventional hydrocarbons (Shale Gas/Oil and Gas Hydrate). Operators employing enhanced recovery techniques for shale gas extraction are offered reduced royalty rates and various tax benefits. These incentives are designed to make the deployment of such technologies more economically attractive.

3.2.2 Shale gas exploration in Country

Under the Shale Gas Policy - 2013, 50 blocks in 4 basins; Assam, Krishna Godavari, Cauvery & Cambay were identified by ONGC, and 6 blocks in 2 basins; Jaisalmer and Assam were identified by OIL in the Phase-I of exploration which ended in April-2017. Basin-wise work carried out by ONGC and OIL in their nomination areas are as below:

Table 7.7: Basin-wise work carried out by ONGC in its nomination areas

Basin	Phase-I Blocks	Blocks Taken up for Drilling	Actual Wells Drilled
Cambay	28	16	17
KG	10	6	8
Cauvery	9	1	3
Assam	3	2	2
Total	50	25	30

Table 7.8: Basin-wise work carried out by OIL in its nomination areas

Basin	Phase-I Blocks	Blocks Taken up for Drilling	Actual Wells Drilled
Jaisalmer	1	1	1
Assam	5	0	3
Total	6	1	4

3.2.3 Future Opportunity

1. In 2018 GoI has allowed E&P operators in India to explore and develop all unconventional hydrocarbons (CBM, shale oil and gas, tight gas) under existing production sharing contracts, CBM blocks, and nominated licenses. This allows the exploration and development of shale gas/oil in existing PML areas.
2. The Barren Measure Formation underlying the Raniganj formation in Raniganj Coalfields (located in West Bengal and Jharkhand state) is rich in organic content consisting dominantly of shale interbedded with silt and the Formation is considered to have good potential for shale gas.

Preliminary studies carried out by existing CBM operators i.e. M/s GEECL & M/s EOGEP L incorporating all the available datasets have shown presence of considerable thickness of Barren Measure shale across the basin.

3.3 Gas Hydrates

3.3.1 Governing Policies:

The National Gas Hydrate Program (NGHP) is an initiative by the Government of India aimed at exploring and exploiting gas hydrates as a potential source of energy with an objective to conduct comprehensive surveys to assess the potential of gas hydrate resources in Indian offshore areas, particularly in the Krishna-Godavari (KG), Mahanadi, and Andaman basins.



3.3.2 NGHP Expeditions

1. NGHP Expedition 01 (2006):

The first expedition was primarily an exploratory mission to identify gas hydrate occurrences. Under NGHP-01, 39 holes were drilled to explore the presence of gas hydrate at 21 sites in Krishna-Godavari (KG), Mahanadi, Andaman, and Kerala-Konkan Basin. Except for Kerala-Konkan, the presence of gas hydrate was established in all three basins, but such gas was proved to be non-exploitable with existing technologies.

2. NGHP Expedition 02 (2015):

This phase focused on delineating gas hydrate deposits in the Krishna-Godavari Basin and assessing their potential for future production. Advanced drilling techniques and sophisticated logging tools were used to gather detailed data on the hydrate-bearing sediments. 42 holes were drilled at 25 sites in KG and Mahanadi Basin. Sand reservoirs with gas hydrate were located at two places in KG Basin and the considered to be prospective for future production testing.

3.3.3 Future opportunity

1. As per 3rd Advisory Committee deliberation during 7-8th November 2019, NGHP-03 Expedition is proposed to focus on the identification and characterization of specific candidate test sites in and around the discovered gas hydrate accumulations at Sites NGHP-02-16/17/20/23 (Area-B) and Sites NGHP-02-8/9 (Area-C). In absence of new information about the occurrence of significant sand-hosted gas hydrate reservoirs in other potential regions, the committee recommended focusing on only the known Area B and Area C gas hydrate accumulations.
2. NGHP-03 is proposed to have 3 phases. Phase 1 would deal with the detail planning effort in support of the gas hydrate field test. Phase 2 (NGHP-03A includes LWD and coring operations and Phase 3(NGHP-03B) would be production test which can be 60-90 days duration (long depressurization).

3. The time gap between the two expeditions would be 10-12 months, required to integrate the results of the NGHP-03A Expedition into the design of the NGHP-03B production test. Time between the two expeditions would also be needed to deal with the purchase and construction of "long-lead" deliverables required for the production test well completion.
4. As a part of U.S.-India Strategic Clean Energy Partnership (SCEP), methane hydrate has been included as a specific agenda of actionable area and on 14.06.2023, one such meeting was held between U.S. and India teams to discuss on current advances in gas hydrate research in India and USA.
5. DGH has constituted a Task Force for periodical monitoring of NGHP-mandated activities including committee level deliberations focussing on global gas hydrate research.
6. DGH is presently in process to get updates of the ongoing projects including new proposed projects by NGHP members and various IITs like IIT-Madras, IIT-Kanpur, IIT-Bombay & IIT-Delhi. As the next step forward, the 38th Technical Committee Meeting, followed by 4th Advisory Committee meeting will be scheduled for due deliberation as a part of future plans under NGHP.



8

Ease of Doing Business - Expediting Clearances for E&P Operations



The oil and gas sector, a vital component of India's core industries, plays a significant role in shaping economic decision-making across various sectors.



8.0 Towards Development: Efficient Statutory Clearances related to environment in Oil & Gas

The oil and gas sector, a vital component of India's core industries, plays a significant role in shaping economic decision-making across various sectors. As India's economic growth accelerates, its energy demand increases, underscoring the rising need for oil and gas and presenting considerable investment opportunities. However, this development must be balanced with robust environmental protection and sustainable development practices. Implementing advanced technologies to reduce emissions, adhering to stringent regulatory standards, and fostering ecosystem restoration initiatives are essential to minimize the sector's environmental impact. In this context, obtaining prior statutory approvals from the relevant authorities is crucial for ensuring environmental protection.



Prior to commencing exploration and production activities, operators in the oil and gas sector are required to obtain a series of statutory permits and approvals from both the State Government and Central Government bodies. These include essential licenses such as the Petroleum Exploration License (PEL), Petroleum Mining Lease (PML), and a range of environmental clearances such as environment, forest, and wildlife clearances. Additionally, approvals from the Ministry of Defence, the Department of Space, as well as Consent to Establish (CTE) and Consent to Operate (CTO) are mandated. Delays in securing these clearances and approvals can significantly impact project timelines and overall progress in exploration and production endeavors.

Statutory clearances play a pivotal role in the upstream oil and gas sector, ensuring that activities are conducted in a manner that does not pose undue harm to the environment. These clearances are imperative for several reasons. They ensure compliance with established environmental laws and regulations aimed at protecting natural ecosystems and preventing degradation. Moreover, the process of obtaining environmental clearances typically involves public participation, facilitating transparency and incorporating public feedback into project designs. This engagement ensures

that community concerns are addressed, enhancing overall project acceptance. In terms of regulatory compliance, oil and gas companies must navigate a complex landscape of environmental legislation governed by central and state authorities responsible for appraisal and approval. Simultaneously, obtaining these statutory clearances poses significant challenges and is often a time-consuming process. This delay adversely impacts the initiation of petroleum operations on-site, ultimately resulting in financial losses for the nation.

Role of DGH:

The Directorate General of Hydrocarbons (DGH) has undertaken initiatives to expedite the issuance of licenses and clearances by addressing procedural inefficiencies, fostering regular communication with relevant authorities, and ensuring strict adherence to existing regulatory frameworks.

Expediting clearances for E&P operations in the upstream oil and gas sector is essential for improving the ease of doing business and attracting investment. By implementing a single-window clearance system, digitalizing processes, streamlining EIAs, improving stakeholder engagement, and building regulatory capacity, governments can create a more conducive environment for E&P activities. These measures not only reduce delays and costs but also ensure that environmental and social impacts are effectively managed, promoting sustainable development in the oil and gas industry.

In recent years, the Directorate General of Hydrocarbons (DGH) has undertaken various efforts to streamline and expedite the clearance process, thereby improving efficiency and speed. These efforts, reflected through policy and procedural relaxations by MoEFCC, have been meticulously documented in chronological order to ensure clarity and comprehension.



8.1 Environment Clearance:

8.1.1 Year 2019:

May 2019: Streamlining Grant of Approvals for Oil Exploration:

A Committee headed by the Vice-chairman, NITI Aayog and comprising of Cabinet Secretary, Chief Executive Officer, NITI Aayog, Secretary, Ministry of Petroleum and Natural Gas, Secretary, Department of Economic Affairs and Chairman & Managing Director of Oil and Natural Gas Corporation was constituted in October, 2018 for suggesting reforms in Exploration & Production (E&P) Sector to enhance domestic Oil & Gas Exploration and Production. The Committee, in its report inter-alia recommended constitution of an Empowered Coordination Committee (ECC) under the chairmanship of Cabinet Secretary for streamlining and expediting grant of approval/clearances.

Empowered Coordination Committee (ECC) was constituted in May, 2019 under the Chairmanship of Cabinet Secretary, for considering matters relating to delay in granting various clearances, approvals etc. Till date, 07 ECC meetings have been conducted.

Pursuant to the ECC meetings, following steps have been taken:

- I. Petroleum Exploration Licenses (PELs) have been granted in all Blocks awarded under Open Acreage Licensing Policy Round-I in the states of Assam, Madhya Pradesh, Gujarat & some blocks of Arunachal Pradesh,
- II. Petroleum Mining Leases have been granted for many Discovered Small Fields and Nomination blocks in Assam, Tripura, Gujarat and Andhra Pradesh,
- III. EC/FC/WLC/CRZ have been granted in the State of Assam, Tripura, Arunachal Pradesh, Gujarat, Jharkhand, Andhra etc.
- IV. Notification of Eco Sensitive Zone (ESZ) has already been issued around 16 protected areas.

V. Various policy issues related to environment have been resolved, some major ones are as follow:

- a. Providing for composite clearance (Category A) for Exploration, Development and Production under Schedule to EIA notification April 2022
- b. Exemption of exploratory drilling from purview of EIA notification, 2006 as per notification 16.01.2020.
- c. Non-requirement of Forest Clearance for PEL/PML grant as per FC rules 2022
- d. Creation of a distinct category for FC Approval in PARIVESH 2.0. along with a Separate form
- e. Exemption from FC Act for underground oil and gas operations in forest area, by drilling from outside forest through Directional Drilling by MoEFCC OM dated 12.09.2023

8.1.2 Year 2020

January 2020: Exemption of exploratory drilling from purview of EIA Notification, 2006:

MoEF&CC vide notification dated 16th January, 2020 categorized onshore and offshore oil and gas exploration activities as B2 category for seeking priority Environment Clearance (EC).

From the perspective of the upstream O&G industry, the exemption of B2 projects from conducting EIA studies and holding Public Hearings has been a significant development in overcoming roadblocks. Additionally, the Scoping stage (ToR) is not required for B2 projects, further simplifying the process.

March 2020: Permission for Use of Secondary Data for EIA studies

The matter was discussed in the ECC meetings under chairmanship of Cabinet Secretary. EIA notification is applicable up to 12 NM and MoEF&CC has taken a view that projects located in offshore areas beyond 12 NM are not covered



under EC. This has enabled the upstream E&P oil and gas companies to use secondary data as the baseline data beyond 12 NM.

8.1.3 Year 2021

March 2021: Streamlining EDS

MoEF&CC vide OM dated 15th March 2021, attempted to streamline the process of granting Environment Clearances about Essential Details Sought (EDS) by placing a ceiling of 30 days after which the MoEF&CC shall exclude the proposal from the pendency list. This issue had been pursued by DGH since long and has given a respite in terms of breaking the deadlock between the E&P Operators and the Ministry in terms of movement of the proposal.

December 2021: Application for B2 Projects

15th December 2021:

EC application form for B2 projects was released by MoEF&CC to enable them to fill in the application. Upstream industry is supposed to fill Form-2 on PARIVESH in case the proponents are going for an exploration surveys.

8.1.4 Year 2022

April 2022: Simplification in CRZ procedure for exploration drilling

Earlier, under EIA Notification 2006 the composite clearance was given to Oil & Gas proposals, whereas EC and CRZ both clearances were involved, which demanded time in approval. Therefore, DGH requested for exemptions for exploratory drilling and seismic surveys from Coastal Regulation Zone (CRZ) notification Jan, 2019 through ECC meetings for early initiation of E & P activities at site. Considering the fact that exploration activities are very temporary and short duration activity the matter was discussed in the subsequent meetings of ECC.

However, after a series of communications and meetings with DGH, MoEF&CC, in 26.04.2022 and 29.11.2022 Office memorandum have been issued by MoEF&CC elaborating the procedure

for clearance of permissible activities as per the CRZ notification, 2011/IPZ notification 2011.

This OM clarifies that any project located in CRZ areas that requires EC under Category B shall be considered by the concerned SEIAA only (without involvement of Expert Appraisal Committee(EAC), MoEF&CC as required before issuance of this OM), for issuance of combined EC and CRZ clearance. Thus, the issue of expeditious clearance for exploration activities is addressed by appraisal of drilling activities at the State level by granting composite clearance (EC + CRZ).



May 2022: Rationalization of Validity of EC

In the Lafarge case, the Supreme Court mandated that Environmental Clearance (EC) for projects involving forest land be granted only after obtaining Stage-I Forest Clearance (FC), preventing a fait accompli situation. Accordingly, the Ministry grants EC post Stage-I FC, although appraisals occur in anticipation of FC. FC, under the FCA 1980, is a two-stage process: Stage-I (in-principle) and Stage-II (conditional compliance). Project work can commence only after Stage-II FC and other necessary approvals. To address delays in obtaining Stage-II FC, the Ministry clarified that EC validity is extended by the time taken to obtain Stage-II FC, up to a maximum of two years.



May 2022: Extension of Validity of EC, Simplifying Public Hearings

EC Validity:

The GoI has extended the tenure of Environmental Clearances (EC) granted for existing or new projects. Hydrocarbon Projects would now have a valid EC for a period of ten (10) years. A provision for one (01) year extension has also been incorporated.

Easing out of Public Hearing process:

To streamline the public hearing process and reduce undue delays, the EIA Notification was amended on 09.05.2022. This amendment allows the District Magistrate/District Collector/Deputy Commissioner to authorize an officer not below the rank of Sub-Divisional Magistrate to supervise and preside over public hearings, if the project or activity is confined to one sub-division. This measure addresses the frequent postponements due to the unavailability of higher-ranking officials. Additionally, the amendment mandates a fifteen-day notice period for rescheduling public hearings, ensuring the public has adequate time to submit written responses.

June 2022: Standardizing the validity of Baseline data, streamlining the issuance process of certified compliance report

Standardizing the validity of Baseline data:

The MoEF&CC in its OM dated 08.06.2022 standardized the validity of baseline data and public consultation reports for submission of proposal within the validity period of terms of Reference (ToR) under the provisions of the EIA Notification, 2006.

The OM clarifies that the baseline data and the Public Hearing shall not be more than three (03) years at the time of submission of the application for consideration of EC.

Streamlining the issuance process of certified compliance report(CCR)

In the oil and gas sector, the drilling of additional exploration and development wells is considered an expansion project and requires

a Compliance Certification Report (CCR) from the Integrated Regional Office (IRO) of the Ministry of Environment, Forest and Climate Change (MoEFCC). This process can be time-consuming. However, the MoEFCC issued an Office Memorandum (OM) on June 8, 2022, regarding the requirements and validity of CCRs, establishing a three-month timeframe for the issuance of CCRs from the date of application by the project proponent. This measure aims to facilitate the timely issuance of CCRs.

April 2023: Provision of split EC transfer

As per EIA notification amendment S.O. 1832(E) dated 21.04.2023, a prior-Environmental Clearance granted for a specific project, except mining projects may be split amongst two or more legal persons, entitled to undertake the project and transferred during the validity to another legal person on application made by the transferor in the format specified on PARIVESH portal to the concerned Regulatory Authority along with requisite documents. The concerned Regulatory Authority shall split and transfer the prior-Environmental Clearance, on the recommendation of the concerned Expert Appraisal Committee to the other legal persons for the respective projects.

8.2 Forest Clearance:

Forest Clearance is a crucial process which requires permission from the Govt of India to divert forestland for non-forest purposes, such as mining, industrial projects, highways, and other infrastructure development projects. This approval is governed by the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980. The approval is granted only after a detailed examination of the proposal and its impact on the forest and its biodiversity, as well as the rights of local communities. A multitude of policy changes/additions have taken place in the last 6 years which have facilitated the E&P O&G industry to a great extent.

The narrative placed below explain the said reforms in detail:



8.2.1 Year 2019

September 2021: Guidelines specific to hydrocarbon sector for undertaking seismic surveys and exploratory drilling in forest areas. The MoEF&CC in its OM dated 30.09.2019 clarified that for the purpose of seismic survey, the maximum permissible number of shot holes may be fixed as 80 per sq km of maximum size of 6.5 inch each so that reliable data can be collected. The permission for such activity

can be granted at State level. Further, Ministry also clarified that the State Govt shall not insist on approval under section 2(iii) of FCA, 1980 at the time grant of PEL. However, the user agencies shall take all statutory permission before executing of lease/breaking of land.

8.2.2 Year 2022

November 2022: Separate & Distinct category for “Mining of Mineral Oil”

DGH has been pursuing for creation of distinct and separate category for the oil and gas sector since the nature of operations of Oil and Gas Exploration and Production and Conventional Mining are completely different. MoEF&CC has acceded to DGH's request by creating a separate head as “Mining of Mineral Oil” to cater to the hydrocarbon projects on PARIVESH web portal without any procedural changes. MoEF&CC had also done suitable changes as per petroleum sector in forest clearance form. This is intended to ease out the operators in applying for forest clearance in areas of fresh diversion considering the content of the form is quite compatible with the terms used in E&P O&G sector.

June 2022

Forest (Conservation) Rules 2022

The MoEF&CC notified the FC Rules 2022 on 28th June, 2022. It is conferred by Section 4 of the FCA, 1980 and in supersession of the FC Rules, 2003 including following requests in favor of HC sector:

- (i) Non- requirement of FC approval for grant of PML/PEL

- (ii) Provision of accredited Compensatory Afforestation (ACA) to create land bank
- (iii) Delegation of power upto 5 ha for FC grant to IRO

However, these rules were later superseded by the FC rules of 2023.

8.2.3 Year 2023

June 2023: Issuance of new FC Rules 2023

The MoEF&CC notified the FC Rules 2023 on 29th November, 2023. It is conferred by Section 4 of the FCA, 1980 and in supersession of the Forest (Conservation) Rules, 2022. The provisions of FC Rules, 2023 include the following:

Constitution of Committees:

The Rules have advocated the constitution of advisory committee, a regional empowered committee at each of the integrated regional offices and a project screening committee at State/ Union Territory (UT) government-level.

Regional Empowered Committees:

All linear proposals involving forest land of more than five hectares, all proposals for use of forest land having canopy density upto 0.7 for the purpose of survey irrespective of their extent and all other proposals involving the use of more than five hectares and up to forty hectares forest land, shall be referred, after examination of its completeness, by the Regional Office to the Regional Empowered Committee.

Project Screening Committee:

As per the new FC Rules 2023, the State Government and Union territory Administration may, by an order, constitute a Project Screening Committee to examine the completeness of the proposal submitted. The committee is supposed to meet at least twice every month and will advise the state governments on projects in a time bound manner. The PSC brings a lot of time saving into the mundane processes of incomplete documents and to and fro query processing. This shall certainly reduce the delays.



Delinking of PEL/PML from FC:

No approval is required for assignment of Petroleum Exploration License (PEL) or Petroleum Mining Lease (PML) where the physical possession or breaking of forest land is not involved.

Compensatory Afforestation:

It is a mandatory process for mitigating the impacts of human activities on the environment and for promoting sustainable development. The MoEF&CC in consultation of States/UTs has taken cognizance of this fact and has facilitated the creation of land banks, a step towards ease of doing business.



Accredited Compensatory Afforestation (ACA):

Compensatory afforestation refers to planting activities done in lieu of diversion of forest for non-forest purposes such as mining, setting up of an industry or an infrastructure project. Earlier, a project developer had to provide land which is not notified as forest against forest diversion and had to bear the cost of undertaking compensatory afforestation over the same piece of land.

The new rules, however, make way for private individuals who develop such plantation sites on their own land and sell them to project developers. Now, anyone can raise a plantation on his land and get benefitted from it. This is a positive step towards encouraging agroforestry and also a move towards sustainable development.

Furthermore, all entities registered for accredited compensatory afforestation shall register with the Green Credit Registry under the Green Credit Policy Implementation

Rules, 2023 and besides their eligibility for compensatory afforestation in lieu of diversion of forest land, the accredited compensatory afforestation will also be eligible for allocation of green credits under the Green Credit Policy Implementation Rules, 2023.

8.3 Advances vis-à-vis Protected Areas:

Protected areas, recognized for their natural, ecological, or cultural values, are safeguarded under the National Wildlife Action Plan (2002-2016) of the MoEF&CC. State Governments must declare land within 10 km of national parks and wildlife sanctuaries as Eco-Sensitive Zones (ESZs) under the Environment (Protection) Act, 1986. This 10 km rule can extend beyond for ecologically significant corridors.

In 2019, the Directorate General of Hydrocarbons (DGH) prioritized finalizing ESZs near 52 protected areas with oil and gas potential. As a result, 36 ESZs are finalized, and 16 are under review, enhancing the Exploration and Production (E&P) industry's capabilities.



8.4 Coordination with State Governments:

DGH has pursued the pending clearances (environment, forest and wildlife, CRZ) and licenses (PEL/PML) with the various State Governments. Since 2023, approx. 120 clearances and licenses have been resolved as of now. There are approx. 132 cases where DGH is continuing its endeavours for facilitation of the approvals from the State and Centre.

In addition to regular coordination meetings with the State Government(s), DGH regularly attends the Fortnightly Regional Co-ordination Meeting (FRCM) between IROs with the State authorities and user agencies and monthly Inter- Ministerial coordination meeting(ICMC) in MoEFCC to expedite the clearance proposals related to oil and gas sector.

8.5 Urja Pragati Portal:

DGH aims to enhance E&P activities in India by fostering deeper stakeholder engagement. The 'Urja Pragati' portal, developed by the Environment division of DGH, expedites clearances and facilitates coordination between E&P operators and State Officials. This web-based portal serves as a single point for filing grievances. It offers a single-window interface for stakeholders and addresses bottlenecks in statutory and regulatory clearances, ensuring transparency, accountability, and responsiveness through features like issue tracker, document repository, and e-communication module.



8.6 Stakeholder Workshops:

The Directorate General of Hydrocarbons (DGH) has played a pivotal role in organizing workshops involving Central Government officials and representatives from the Exploration & Production (E&P) Oil and Gas industry. The primary objective of these workshops is to provide comprehensive support to E&P operators. This includes offering services such as the sharing of facilities and infrastructure available at DGH, creating a Knowledge Sharing Platform, and organizing regular workshops, seminars, conferences, training sessions, and discussions.



To date, the Environment Division of DGH, in collaboration with the Ministry of Environment, Forest and Climate Change (MoEFCC), has conducted three joint workshops aimed at sensitizing operators to the latest Government policies, technologies, and usage of inventories, as well as recent policy reforms in the areas of Environmental and Forest Clearances (EC and FC). These workshops have facilitated positive interactions between the Government and key stakeholders, namely the Project Proponents. The sensitization workshops on EC and FC were held on June 10, 2022, September 30, 2022, and June, 20, 2023, respectively.



8.7 Formation of North East Coordination Cell

To streamline and expedite the process of regulatory clearances for Exploration and Production projects particularly in the North-East region of India, DGH established the North East Coordination Committee (NECC) on July 02, 2021. This committee operates within the framework of the Hydrocarbon Cell (HCC) under DGH, in collaboration with National Oil Companies, the North Eastern states of India, and other relevant stakeholders. As part of the operational strategy under the HCC, young professionals with designation of Hydrocarbon Professional, have been appointed to serve as a centralized point of contact for all regulatory matters. This initiative aims to address the identified bottlenecks in the timely issuance of statutory clearances, particularly within the North-Eastern states. Currently, 16 hydrocarbon professionals are associated with this cell, and they are posted in various state departments across Assam, Arunachal Pradesh, Tripura.





Highlights of Hydrocarbon Professionals' Participation in Site Visits, Coordination Meetings with State Officials and Meetings Addressing FRA/Land Encroachment Issues / Public hearing

8.8 Reports and Other Initiatives undertaken in DGH about environmental concerns

May 2021: Guidelines for Environmental Impact Assessment Studies on Petroleum Exploration and Developmental Projects in Offshore Areas beyond 12 Nautical Miles.

In a bid to increase India's hydrocarbon exploration and production (E&P) footprint to address the rising energy demand, areas are being considered for auctioning/bidding purposes. The MoEF&CC has guidelines for operating E&P operations within 12 NM only in offshore areas. Therefore, DGH sponsored a study in May 2021 to formulate guidelines and the best practices to operate in the areas beyond

12 NM in offshore areas, by utilizing the services of Council of Scientific & Industrial Research (CSIR)- National Institute of Oceanography (NIO). NIO finalized the reckoner/handbook in March 2023 to facilitate the E&P operators in the entire hydrocarbon block cycle of exploration, drilling, development, production, and site restoration.

February 2023: Preparation of Handbook for environmentally relevant clearance procedures and guidelines for upstream Oil and Gas Exploration and Development Operations.

E&P projects must obtain several statutory approvals from various Central and State authorities, such as Environment Clearance,



Forest Clearance, and Wildlife Clearance. Delays in obtaining these approvals can postpone the initiation of on-site activities. These delays in licenses and clearances have been the primary bottleneck in oil and gas E&P projects across the country, hindering the early monetization of these projects.

To streamline the clearance processes and facilitate faster monetization of blocks and fields, the creation of a handbook compiling environmentally relevant clearance procedures and guidelines was deemed necessary. To assist and guide E&P operators, a study was proposed to identify the probable causes of inordinate delays in obtaining environment-related clearances. Consequently, the Assam Science Technology & Environment Council (ASTEC) has prepared a compiled and comprehensive handbook for the benefit of E&P operators.

September 2023: Preparation of a documentary film on environment-related impacts due to upstream Oil & Gas Exploration and Production activities

There are numerous myths associated with the oil and gas sector, with local communities often comparing Exploration and Production (E&P) activities to conventional mining operations. However, these activities are distinct in their operations. To address these misconceptions, the Directorate General of Hydrocarbons (DGH) has prepared a documentary exploring the environmental aspects of Oil Exploration and Production (E&P) in India.



The documentary aims to dispel myths related to each stage of petroleum operations by emphasizing responsible practices and adherence to regulations. It highlights the positive socio-economic impacts of E&P, such as

health programs, skill development initiatives, and environmental conservation efforts. This documentary serves to educate and raise awareness about the industry's commitment to sustainability and its contributions to local communities and the environment.

Documentary link: https://dghindia.gov.in/assets/downloads/MythsVS_Reality.mp4

September 2023: Impact of extreme events and Climate Change on E&P activities in the Offshore area” by Council of Scientific & Industrial Research (CSIR)- National Institute of Oceanography (NIO), Goa.

This project is focused mainly on the study of the vulnerability of coastal & offshore oil & gas infrastructure.

This project also includes the preparation of a Standard Operating Procedure (SOP), which is essential for the facilitation of operators, considering climate change effects to evaluate the risk on time and provide early warnings to adapt or prevent the unforeseen impacts on the oil & gas industry. Report is in progress.

November 2023: Non-applicability of Forest (Conservation) Act, 1980 to Extended Reach Drilling (ERD) locations

ERD, a directional drilling technique for long horizontal wells, enhances production by covering a larger area from a single site and extending well distance in a reservoir. Since 2020, DGH has advocated to MoEF&CC that ERD, a globally adopted and safe technology, should not be subject to FCA, 1980, as it does not divert actual forestland. After extensive meetings and discussions with DGH and other experts, MoEF&CC agreed on 12.09.2023, through its office memorandum subject to certain conditions. This office memorandum acknowledges the safety and efficiency of ERD while ensuring compliance with environmental safeguards, thus facilitating its use without compromising forest conservation.

- i. The station for ERD will be setup outside the forest area at a minimum distance of 500 meters and which should be at least



1 Km from the Protected Areas /corridors/ wildlife sensitive areas.

- ii. The State Government shall ensure that the recommendations made in the General Standard Operating Procedures, annexed as Annexure-I, submitted by the Wildlife Institute of India will be complied with strictly by the User Agency.
- iii. The DGH will facilitate the formulation of detailed regional-specific guidelines by the Wildlife Institute of India. The necessary financial support, as will be required by the WII, will be arranged by the DGH.
- iv. The Region-Specific guidelines, as may be prescribed by the WII, will be complied with by the User Agency and DGH. An undertaking in this regard, wherever applicable, will be obtained by the State Government while allowing drilling through ERD technology.
- v. The exemption considered for the ERD technology will not be applicable if the drilling area falls inside the Protected Areas notified under the Wild Life (Protection) Act, 1972 and Eco-Sensitive zone of Protected Areas.

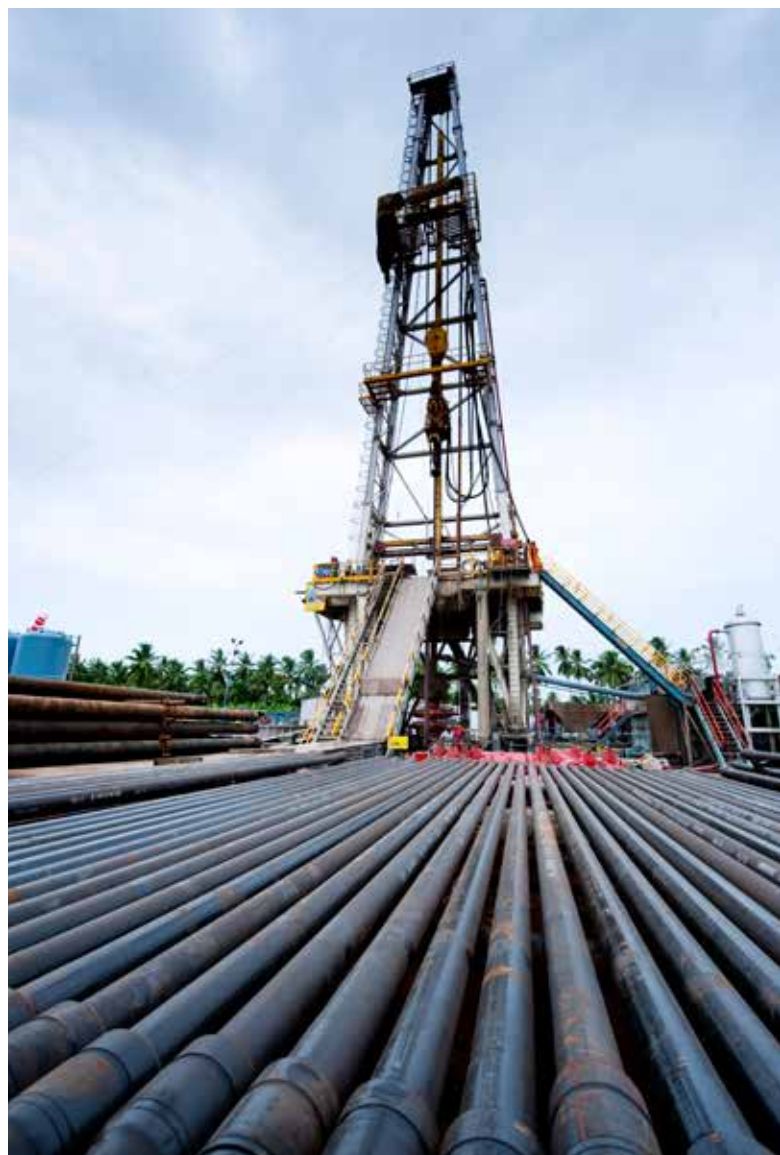
November 2023: Research study to be conducted by WII for impact assessment of Extended Reach Drilling (ERD)/Horizontal Directional Drilling (HDD) technologies with surface facilities on wildlife and above-ground biodiversity of the forest, outside the forest boundaries.

ERD/HDD technologies are eco- friendly technologies for extracting oil and gas from remote and otherwise inaccessible locations, including areas of ecological significance such as National Parks and Bird Sanctuaries. It is noteworthy that earlier, these technologies necessitate Forest Clearance under FC Act, 1980.

Considering that this is an advanced environment friendly technology, the matter was placed before the ECC in 2020 as a policy issue "The non-applicability of Forest (Conservation) Act, 1980 for Oil & Gas projects

implemented by utilizing ERD (Extended Reach Drilling) technology from outside the forest area without any diversion of forest land".

The proposal was accepted by the MoEFCC through an Office Memorandum dated September 12, 2023, subject to certain conditions. Among these conditions was a directive for the DGH to provide financial support to the WII for developing region-specific guidelines. In response, the WII submitted a proposal for a five-year study with a budget of 8.4 Crore. This proposal received in-principle approval from the DGH and is currently awaiting final approval from the MoPNG. It is anticipated that the project will commence soon, bringing benefits to all E&P operators.



HIGHLIGHTS from Environment and Lease & License division

If the E&P operations involve diversion of forest land, the FC under FCA, 1980 is required.

FC Rules have been renotified on 29.11.2023 to give special considerations to the E&P industry

Exemption from Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 for underground oil and gas operations in forest area, by drilling from outside forest boundary through Extended Reach Drilling/ Horizontal Directional Drilling.

Many myths surround the oil and gas sector, with local communities often likening E&P activities to conventional mining. To debunk such myths, the DGH produced a documentary highlighting the environmental aspects of Oil Exploration and Production (E&P) in India.

As a result of active coordination by DGH, approximately 33 PEL/PML have been resolved in Gujarat. In Andhra Pradesh, the state government issued 10 PML in 2023.





9

Hydrocarbon Efficiency & New Energy



The intersection of hydrocarbon efficiency and new energy sources in India's energy landscape presents a dynamic arena where sustainability and economic growth converge.



Energy Transition - Role of Hydrocarbon Efficiency and New Energy:

India, at the COP 20 announced its target to achieve net zero by 2070, the intersection of hydrocarbon efficiency and new energy sources in India's energy landscape presents a dynamic arena where sustainability and economic growth converge. Prioritizing initiatives to enhance hydrocarbon efficiency and facilitate the transition to new energy sources is paramount for India's sustainable development. These measures are crucial to strengthen our nation's energy security, reducing dependence on imported fossil fuels, and mitigating vulnerability to global market fluctuations. Additionally, they play a vital role in addressing India's environmental challenges, including air pollution and climate change, by curbing emissions of greenhouse gases.

Investing in low carbon and renewable technologies, not only expands access to clean and affordable energy but also stimulates economic growth through



job creation, the growth of domestic industries, and potential export opportunities in the global clean energy market. Improving energy efficiency yields significant cost savings for E&P businesses while strengthening India's commitment to meeting its climate goals

under international agreements. Prioritizing hydrocarbon efficiency and embracing new energy sources is essential for ensuring sustainable development, economic prosperity, and environmental stewardship.

INDIA'S 'PANCHAMRIT' AT COP26

by Prime Minister Narendra Modi

1. Reach non-fossil energy capacity to 500GW by 2030
2. Fulfil 50% energy requirements via RE by 2030
3. Reduce 1 bn carbon emissions by 2030
4. Reduce carbon intensity >45% by 2030
5. Achieve the target of Net-Zero by 2070

India's Emission Scenario & Commitments:

India being one of the fastest-growing major economies globally with a large and dynamic market coupled with significant domestic reforms and investment in energy &

infrastructure. On the other hand, India stands as the world's third-largest emitter of CO₂, having reached a new record high of 2.7 billion metric tons (GtCO₂). This positions India closely behind the USA and China in terms of gross CO₂



emissions. Despite this significant total, India's per capita CO₂ emissions are relatively low at approximately 1.9 tonnes per annum, which is less than 40% of the global average.

India has set a bold trajectory towards a sustainable future by pledging to achieve net-zero emissions by 2070. This landmark commitment, known as PANCHAMRIT, was announced by the Hon'ble Prime Minister during the 26th Conference of Parties (COP26) in Glasgow, showcasing India's unwavering dedication to combating climate change on the global stage.

India's energy mix is crucial for achieving these ambitious targets. As per Statistical Review 2023 of World Energy by Energy institute, Energy consumption in India is heavily reliant on fossil fuels, with 89% coming from oil, gas, and coal, while only 11% is derived from renewable sources. Achieving net-zero emissions by 2070 requires a holistic approach, including transitioning to new & renewable energy sources, enhancing hydrocarbon efficiency, promoting electrification of transportation, expanding forest cover, investing in carbon capture and storage, reducing dependency on coal, implementing supportive policies, fostering international collaboration, raising public awareness, encouraging green technology investment, and developing adaptation strategies.

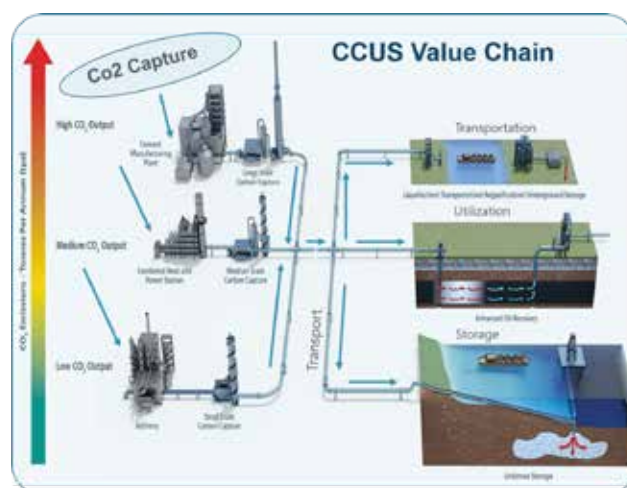


Hydrocarbon Efficiency in E&P Operations:

Hydrocarbon efficiency plays a crucial role in oil and gas exploration operations by optimizing resource utilization, minimizing gas flaring, venting, leakages and enhancing overall operational effectiveness. This involves optimizing processes to maximize hydrocarbon extraction and emission reduction through Enhanced Oil Recovery (EOR), reducing flaring and venting by capturing and utilizing associated gas, reducing fugitive emissions through Leak Detection and Repair (LDAR), adopting low-carbon technologies like Carbon Capture and Storage (CCS) and integrating renewable energy sources.

Carbon Capture Utilisation and Storage (CCUS): CCUS

has emerged as a pivotal technology for mitigating climate change. CCUS involves the capture of CO₂, typically through chemical or physical processes, followed by transportation to designated sites for utilization or injection into geological formations or depleted oil and gas fields for permanent storage and trapping of the CO₂.



Countries like Norway, United States of America, Canada, and the United Kingdom are spearheading CCUS initiatives through robust policies and significant investments. The Intergovernmental Panel on Climate Change (IPCC) underscores the essential role of carbon capture in achieving global decarbonization targets. According to the IEA, approximately 45 commercial facilities are already in operation



globally, applying carbon capture, utilization, and storage (CCUS), with over 700 projects in various stages of development across the CCUS value chain. The projected total amount of CO₂ that could be captured by 2030 is around 435 million tonnes (Mt) per year.

Captured CO₂ can be injected into depleted oil & gas fields, Deep Saline aquifers, fracture Basement Reservoirs (Basaltic Reservoir), enhanced CBM recovery and enhanced oil recovery while providing a permanent storage solution. This dual benefit not only mitigates CO₂ emissions but also optimizes resource extraction, aligning with both sustainability and economic objectives.

Despite its vast potential, CCUS faces significant challenges, primarily related to financing and technological development. High initial costs, uncertain revenue streams, and the need for substantial infrastructure investment pose major financial barriers. Technological advancements are needed to improve capture efficiency, reduce costs, and ensure the safety and reliability of CO₂ storage.

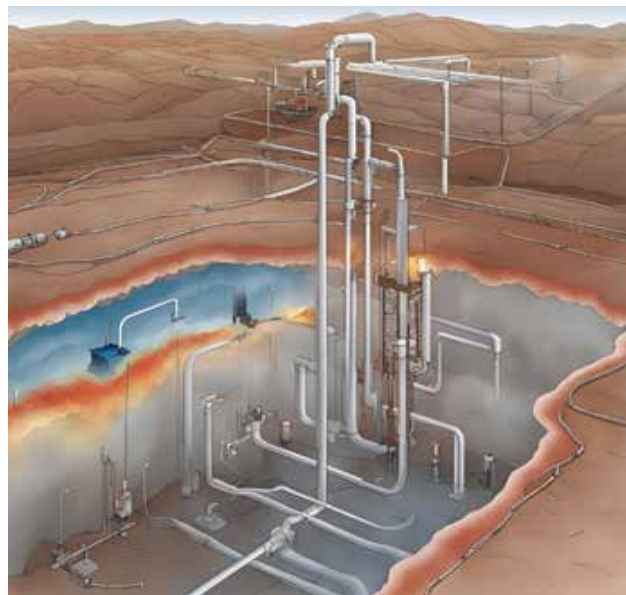
India has recognized the critical importance of CCUS in its climate strategy. Reports from Niti Aayog "CCUS Policy Framework and Deployment Mechanism in India," and the draft report by the Ministry of Petroleum and Natural Gas (MoPNG) "CCUS Road Map 2030", outline the nation's plans to integrate CCUS technologies. These documents highlight the potential for CCUS to support India's energy transition and industrial decarbonization efforts.

In India, CCUS initiative has taken by ONGC who has identified Gandhar field in Gujarat as a pilot project. This project involves CO₂ captured from the Koyali refinery of IOCL for Enhanced Oil Recovery (EOR). Similarly, Oil India Limited (OIL) has identified the Barail Sand of Naharkatiya Oilfield for CO₂ EOR after capturing CO₂ from IOCL's Digboi refinery.

CCUS, being a transformative technology, has the potential to significantly reduce CO₂ emissions.

Geothermal Power: Unlocking Earth's Natural Heat

As the world transiting towards a sustainable future, geothermal energy emerges as a promising and reliable source of renewable power. This versatile resource, harnessing the Earth's internal heat, offers significant advantages over traditional energy sources.

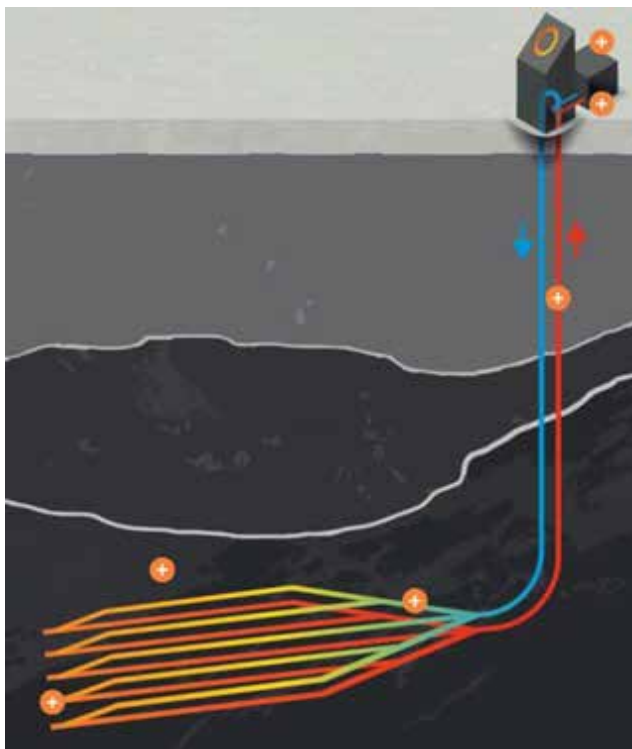


Unlike intermittent renewable sources like solar and wind, geothermal energy offers a remarkably high and consistent capacity factor, meaning it can generate electricity around the clock, unaffected by weather conditions or time of day.

However, its widespread adoption also faces unique challenges that must be addressed through innovative policies, strategic investments, and a shift in public perception.

The emerging new technologies of Enhanced Geothermal System (EGS) and Multilateral Closed Loop Geothermal System based on the multilateral horizontal drilling along with the hydrofracturing has opened new horizons in the field of low to medium enthalpy geothermal reservoirs. The CO₂ Plume Geothermal (CPG) system can contribute to carbon sequestration by storing CO₂ underground while simultaneously generating clean electricity.





The Oil and Gas industries which are well experienced and well equipped for advanced drilling technologies can harness the earth's natural heat for clean energy production through its integration in existing Upstream Operations.

India possesses significant geothermal resources, in regions like the Himalayas, the Deccan Trap, and the Andaman and Nicobar Islands. However, the country's geothermal energy potential remains largely untapped, with only a handful of pilot projects and limited exploration efforts to date. The Sedimentary Basins of India specially the Rift Basins holds high potential for harnessing subsurface geothermal energy using drilled wells.

In India, the Ministry of New and Renewable Energy (MNRE) has drafted Geothermal Energy Development Framework in 2016 aimed at promoting exploration, development, and utilization of this renewable resource. The policy

outlines measures such as resource mapping, financial incentives, and regulatory support to attract investment and foster growth in the sector.

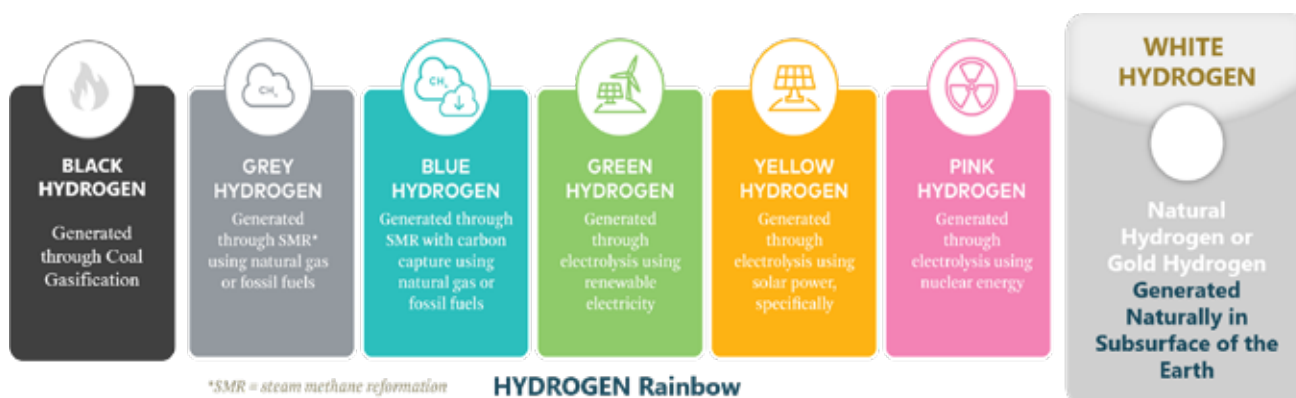
ONGC started the first-ever Geothermal Field Development Project of India in the Puga Valley region of Ladakh in the year 2021.

The development of the geothermal energy industry in India holds immense potential for clean energy, economic growth, and technological innovation, providing a sustainable path forward for decarbonization and reducing dependence on imported fuels and fostering a more self-sufficient and resilient energy landscape.

The Future of Clean Energy in India: Exploring White Hydrogen Landscape

Hydrogen, as a zero-carbon fuel, is a key player in the energy transition and aligns with India's commitments to combat climate change, reduce greenhouse gas emissions, and address poor air quality.





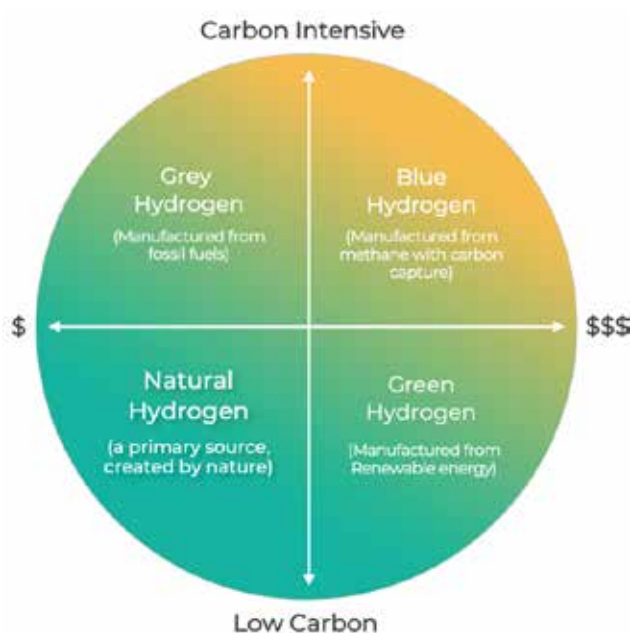
White hydrogen, also known as geologic hydrogen or natural hydrogen, refers to hydrogen gas that is naturally occurring and formed through chemical and geological processes within the Earth's crust. It has gained momentum globally, with active projects in various countries following its accidental discovery in Mali, West Africa.

Unlike green or blue hydrogen, which are produced through electrolysis or steam methane reforming with carbon capture and storage (CCS), respectively, white hydrogen is extracted directly from underground reservoirs where it has naturally accumulated over time. It is considered an attractive option for hydrogen production due to its potentially lower cost and higher specific energy compared to lab-produced alternatives.

There are many ideas about how natural hydrogen forms. Global discoveries indicate that white hydrogen can be found in setups analogous to petroleum systems, with the difference being the source of generation, i.e., the serpentinization of olivine-rich ultramafic rocks. India has all the favorable geology for the generation of hydrogen, and its exploration can be prioritized. For example, sedimentary basins (Vindhyan, Cuddapah, Gondwana, Chhattisgarh, etc.) near major cratonic blocks (Dharwar, Singhbhum), ophiolite complexes (Himalayan region, parts of Arunachal Pradesh, Western Ghats, Nagaland, and Andaman) are promising areas for exploration. Therefore, it has become necessary to evaluate the potential of white hydrogen in India.

The exploration and production methods of natural hydrogen from subsurface formations are synonymous with those of oil and gas E&P operations. In Australia, the Petroleum and Geothermal Energy (PGE) Act 2000 was amended to the Energy Resources Act, with regulatory changes to include hydrogen as a regulated substance. Over 40 licenses for exploring natural hydrogen deposits have been issued since 2021. Similarly, regulatory policy should be formed or amended for explicit exploration and production of natural hydrogen in India.

The Directorate General of Hydrocarbons (DGH), being the nodal agency for oil and gas exploration, will take the initiative to assess



hydrogen exploration potential through promotion, resource assessment studies, and proposing suitable policy reforms, integrating these with oil and gas operations for hydrogen Exploration.

Energy Security: Advancing Hydrocarbon Efficiency and Integrating New Energy

To track progress towards Net-Zero goals, the DGH will coordinate and facilitate E&P operators in achieving their Net Zero Action Plans. This will involve standardizing reporting standards for measuring, monitoring, and conducting periodic reviews of decarbonization efforts. The focus will be on gas flaring, methane venting, IOR/EOR implementations, and renewable energy integration to enhance hydrocarbon efficiency. India will play a major role in the global energy transition by leveraging its vast potential in Carbon Capture, Utilization, and Storage (CCUS), geothermal resources, and white hydrogen production.

A suitable policy framework is necessary for comprehensive monitoring, risk management strategies, and ensuring the integrity and safety of CO₂ storage operations. Field-wise assessments of geological carbon storage, seal and wellbore integrity, as well as techno-economic studies across different geological storage options, are crucial for CCUS implementation. DGH will collaborate with E&P operators and domain experts for data acquisition, technology exchange, and knowledge sharing. Forward-thinking policy frameworks for CO₂ sequestration in dry wells and uniform licensing for composite energy blocks can revolutionize the integration of oil, gas, geothermal, white hydrogen, and renewables.

Technological upgradation and adoption of low-carbon technologies in oil and gas operations involve significant costs. Promoting decarbonization and the transition to clean energy is challenging without financial incentives. Accelerating operator participation

in decarbonization efforts requires facilitating revenue generation from emission reduction and renewable energy integration through carbon credit monetization and trading. This approach can be instrumental in achieving Net Zero targets. DGH shall coordinate with various government agencies and financial institutions to promote green investment.

Integrating new energy sources into existing oil and gas operations plays a vital role in energy transition. Utilizing new energy sources such as geothermal and natural hydrogen can diversify the energy mix, promote domestic energy production, decrease reliance on imports and ultimately reduce GHG emissions. The well-experienced and well-equipped oil and gas industry, with advanced drilling technologies, can harness the Earth's natural heat (i.e., geothermal energy) for clean energy production by integrating it into existing operations and further developing a comprehensive geothermal data bank to promote data driven geothermal operations.

Recent global discoveries of natural hydrogen indicate that India has favorable geological conditions for its generation, though this has not been the primary focus of oil and gas operators. As the nodal agency for E&P operations, DGH will take the lead in assessing the potential for hydrogen exploration through basin resource assessment studies and will implement appropriate policy reforms to integrate this resource with oil and gas operations.

In conclusion, the Directorate General of Hydrocarbons is leading India's ambitious path towards Net Zero emissions by driving comprehensive decarbonization efforts within the oil and gas E&P operations. DGH will pursue to integrating new energy sources such as geothermal and natural hydrogen into upstream operations. By incorporating these initiatives, India not only enhances its energy security but also significantly reduces greenhouse gas emissions, reinforcing its position as a global leader in sustainable energy transition.



Annexures

Figure 10.1: Earned Profit Petroleum (INR Crores)

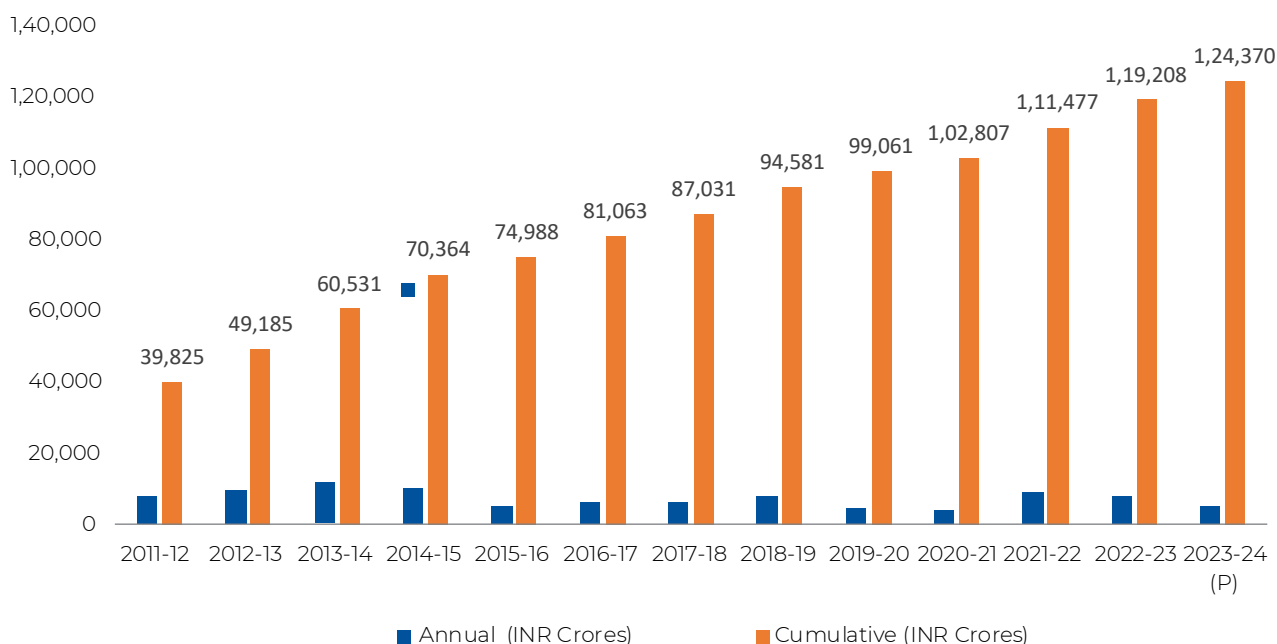


Figure 10.2: Royalty Received by Central Exchequer (INR Crores)

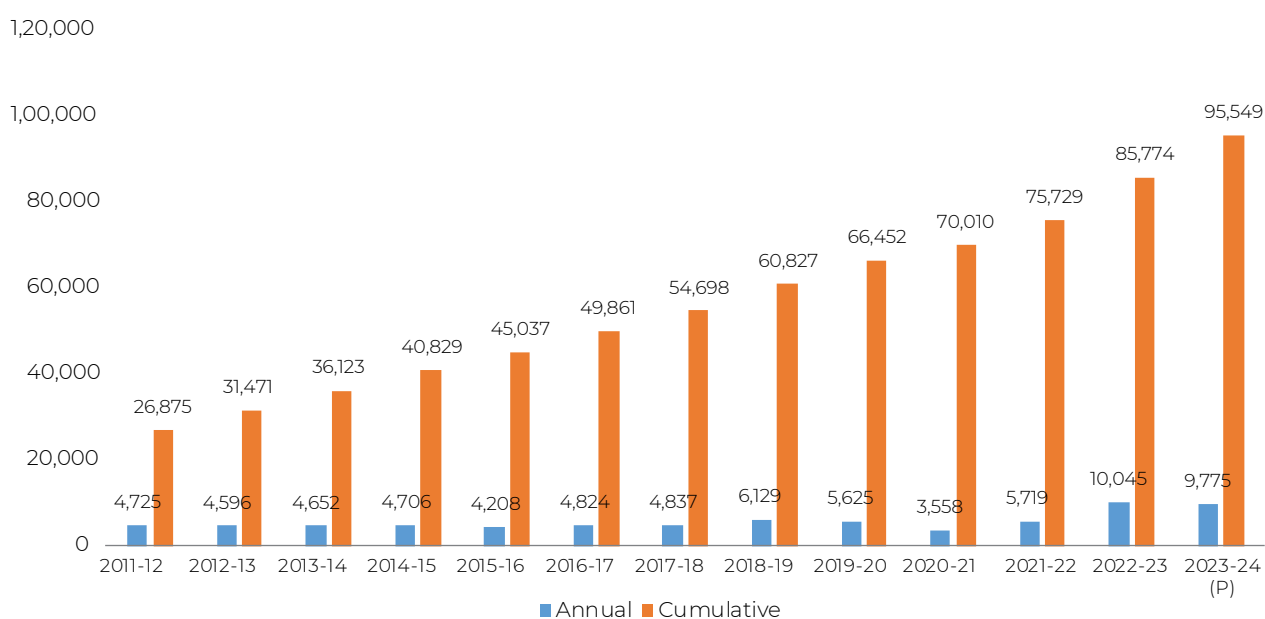


Table 10.1 : Blocks Operational under PSC (as on 31.03.2024)

Sr No.	Block Name	Basin	Consortium (Participating Interest In %)	Bid Round	Location	Awarded Area (In Sq.km)	Present Area (In Sq.km)	Status Of Block
1	AA-ON/7	Assam-Ara-kan Shelf	Assam Company Ltd. (100%) (Op.)	Pre-NELP	Onland	1934	319	Exploratory
2	AA-ONJ/2	Assam-Ara-kan Shelf	Oil and Natural Gas Corporation Ltd. (100%) (Op.)	Pre-NELP	Onland	1277	638	Exploratory
3	AA-ONN-2001/1	Assam-Ara-kan Shelf	Oil and Natural Gas Corporation Ltd. (100%) (Op.)	NELP	Onland	3018.35	968.35	Exploratory
4	AA-ONN-2001/2	Assam-Ara-kan Shelf	Oil and Natural Gas Corporation Ltd. (80%) (Op.), Indian Oil Corporation Ltd. (20%)	NELP	Onland	5340	2660	Exploratory
5	AA-ONN-2002/1	Assam-Ara-kan Shelf	Jubilant Oil & Gas Private Limited. (20%) (Op.), GAIL (India) Limited. (80%)	NELP	Onland	1680	1260	Exploratory
6	AA-ONN-2010/2	Assam-Ara-kan Shelf	Oil India Ltd. (50%) (Op.), Oil and Natural Gas Corporation Ltd. (30%), GAIL (India) Limited. (20%)	NELP	Onland	396	396	Exploratory
7	AA-ONN-2010/3	Assam-Ara-kan Shelf	Oil India Ltd. (40%) (Op.), Oil and Natural Gas Corporation Ltd. (40%), Bharat Petro Resources Ltd (20%)	NELP	Onland	171	171	Exploratory
8	AAP-ON-94/1	Assam-Ara-kan Shelf	Hindustan Oil Exploration Company Limited. (26.89%) (Op.), Oil India Ltd. (44.08%), Indian Oil Corporation Ltd. (29.03%)	Pre-NELP	Onland	870	75.94	Production
9	ALLORA	Cambay	GNRL Oil & Gas Limited Ltd. (100%) (Op.)	Field	Onland	6.85	6.85	Not on Production
10	AMGURI	Assam-Ara-kan Shelf	Oilmax Energy Private Limited 50%) (Op.) , Assam India Company Ltd.(50%)	Field	Onland	52.75	52.75	Production
11	ASJOL	Cambay	Hindustan Oil Exploration Company Limited. (50%) (Op.), Gujarat State Petroleum Corporation Ltd. (50%)	Field	Onland	15	15	Production
12	BAKROL	Cambay	Selan Expl. Tech. Ltd. (100%) (Op.)	Field	Onland	36	36	Production
13	BAOLA	Cambay	Sun Petrochemical Pvt. Ltd. (100%) (Op.)	Field	Onland	4	4	Production



Sr No.	Block Name	Basin	Consortium (Participating Interest In %)	Bid Round	Location	Awarded Area (In Sq.km)	Present Area (In Sq.km)	Status Of Block
14	BHANDUT	Cambay	Kiri Logistics (100%) (Op.)	Field	Onland	6.1	6.1	Production
15	CAMBAY	Cambay	Oilex Ltd.(85%)(Op.), Oilex NL Holding Ltd.(15%)	Field	Onland	161	161	Production
16	CB-ON/2	Cambay	Gujarat State Petroleum Corporation Ltd. (56%) (Op.), Oil and Natural Gas Corporation Ltd. (30%)Geo-Global Resources Inc. (14%)	Pre-NELP	Onland	1618	7.55	Production
17	CB-ON/3	Cambay	Essar Oil & Gas Exploration and Production Limited (EOGEPL)(100%) (Op.)	Pre-NELP	Onland	574	13.72	Production
18	CB-ON/7	Cambay	Hindustan Oil Exploration Company Limited. (35%) (Op.), Gujarat State Petroleum Corporation Ltd. (35%), Oil and Natural Gas Corporation Ltd. (30%)	Pre-NELP	Onland	492	7.64	Production
19	CB-ONN-2000/1	Cambay	Gujarat State Petroleum Corporation Ltd. (50%) (Op.), GAIL (India) Limited. (50%)	NELP	Onland	1424	57.05	Production
20	CB-ONN-2001/1	Cambay	Oil and Natural Gas Corporation Ltd. (100%) (Op.)	NELP	Onland	215	26	Production
21	CB-ONN-2002/3	Cambay	Gujarat State Petroleum Corporation Ltd. (55%) (Op.),Hindustan Petroleum Corporation Limited. (15%), Geo-Global Resources BarbaGeo-Global Resources Barbados (10%), Jubilant Oil & Gas Private Limited. (20%)	NELP	Onland	285	21.29	Production
22	CB-ONN-2003/1	Cambay	Sun Petrochemical Pvt. Ltd. (100%)	NELP	Onland	635	71.33	Production
23	CB-ONN-2003/2	Cambay	Gujarat State Petroleum Corporation Ltd. (50%) (Op.), Jubilant Securities Pvt. Ltd. (20%), Geo-Global Resources Barbados (10%), GAIL (India) Limited. (20%)	NELP	Onland	448	12.69	Production



Sr No.	Block Name	Basin	Consortium (Participating Interest In %)	Bid Round	Location	Awarded Area (In Sq.km)	Present Area (In Sq.km)	Status Of Block
24	CB-ONN-2004/1	Cambay	Oil and Natural Gas Corporation Ltd. (60%) (Op.), Gujarat State Petroleum Corporation Ltd. (40%)	NELP	Onland	32	9.73	Production
25	CB-ONN-2004/2	Cambay	Oil and Natural Gas Corporation Ltd. (55%) (Op.), Gujarat State Petroleum Corporation Ltd. (45%)	NELP	Onland	423	86.556	Production
26	CB-ONN-2004/3	Cambay	Oil and Natural Gas Corporation Ltd. (65%) (Op.), Gujarat State Petroleum Corporation Ltd. (35%)	NELP	Onland	113	10.78	Not on Production
27	CB-ONN-2005/10	Cambay	Oil and Natural Gas Corporation Ltd. (100%) (Op.)	NELP	Onland	270	63.59	Exploratory
28	CB-ONN-2005/9	Cambay	Mercator Petroleum Private Limited. (100%) (Op.)	NELP	Onland	132.2	31.37	Not on Production
29	CB-ONN-2010/11	Cambay	Bharat Petro Resources Ltd (29.41%), GAIL (India) Limited. (47.06%)(Op.), Engineers India Ltd. (23.53%)	NELP	Onland	144.43	21.1	Production
30	CB-ONN-2010/5	Cambay	Pan India Consultants (20%) (Op.), Frost International Ltd (45%), FTA HSRP Solution (15%), Pan India Holding Pvt. Ltd (10%), Naharwar Marketing Service Pvt. Ltd(10%)	NELP	Onland	49	68	Exploratory
31	CB-ONN-2010/8	Cambay	Bharat Petro Resources Ltd (25%) (Op.), Engineers India Ltd. (20%), BF Infrastructure Ltd. (20%), Monnet Ispat & Energy Ltd. (10%), GAIL (India) Limited. (25%)	NELP	Onland	42	42	Not on Production
32	CB-OS/2	Cambay	Cairn(Vedanta) Limited (40%) (Op.), Oil and Natural Gas Corporation Ltd. (50%), Tata Petro-dyne Ltd. (10%)	Pre-NELP	Shallow Water	3534	207.04	Production
33	CB-OSN-2003/1	Cambay	Oil and Natural Gas Corporation Ltd. (100%) (Op.)	NELP	Shallow Water	2394	243	Production



Sr No.	Block Name	Basin	Consortium (Participating Interest In %)	Bid Round	Location	Awarded Area (In Sq.km)	Present Area (In Sq.km)	Status Of Block
34	CY-ONN-2002/2	Cauvery	Oil and Natural Gas Corporation Ltd. (60%) (Op.), Bharat Petro Resources Ltd (40%)	NELP	Onland	280	140	Production
35	CY-ONN-2004/2	Cauvery	Oil and Natural Gas Corporation Ltd. (80%) (Op.), Bharat Petroleum Corporation Limited. (20%)	NELP	Onland	375	126.8	Not on Production
36	CY-OS/2	Cauvery	Hardy Exploration & Production (India) Inc. (75%) (Op.), GAIL (India) Limited. (25%)	Pre-NELP	Shallow Water	5010	859	Exploratory
37	DHOLASAN	Cambay	GNRL Oil & Gas Limited Ltd. (100%) (Op.)	Field	Onland	8.8	8.8	Production
38	DHOLKA	Cambay	Joshi Tech. Inc. (100%) (Op.)	Field	Onland	48	48	Production
39	GK-OSN-2009/1	Kutch	Oil and Natural Gas Corporation Ltd. (50%) (Op.), Indian Oil Corporation Ltd. (25%), Adani Well-spun Exploration Ltd. (25%)	NELP	Shallow Water	1264	517	Exploratory
40	GK-OSN-2010/1	Kutch	Oil and Natural Gas Corporation Ltd. (60%) (Op.), Oil India Ltd. (30%), GAIL (India) Limited. (10%)	NELP	Shallow Water	1361	1077	Exploratory
41	GS-OSN-2004/1	Saurashtra	Oil and Natural Gas Corporation Ltd. (100%) (Op.)	NELP	Shallow Water	6589	552	Development
42	HAZIRA	Cambay	Sun Petrochemical Pvt. Ltd. (100%)(Op.)	Field	Onland	49.73	49.73	Production
43	KANAWARA	Cambay	GNRL Oil & Gas Limited Ltd. (30%) (Op.), Gujarat State Petroleum Corporation Ltd. (70%)	Field	Onland	6.3	6.3	Production
44	KARJISAN	Cambay	Selan Expl. Tech. Ltd. (100%) (Op.)	Field	Onland	5	5	Not on Production
45	KG-DWN-98/2	Krishna Godavari	Oil and Natural Gas Corporation Ltd. (100%) (Op.)	NELP	Deep Water	9756.6	2392.87	Production
46	KG-DWN-98/3	Krishna Godavari	Reliance Industries Ltd. (66.67%) (Op.), BP Exploration (Alpha) (33.33%)	NELP	Deep Water	7645	1174.51	Production
47	KG-ONN-2003/1	Krishna Godavari	Oil and Natural Gas Corporation Ltd. (51%) (Op.), Vedanta Limited (49%)	NELP	Onland	1697	54.46	Production



Sr No.	Block Name	Basin	Consortium (Participating Interest In %)	Bid Round	Location	Awarded Area (In Sq.km)	Present Area (In Sq.km)	Status Of Block
48	KG-OSN-2001/3	Krishna Godavari	Oil and Natural Gas Corporation Ltd. (80%) (Op.), Gujarat State Petroleum Corporation Ltd. (10%), Jubilant Oil & Gas Private Limited. (10%)	NELP	Shallow Water	1850	530.5	Production
49	KG-OSN-2009/3	Krishna Godavari	Vedanta Limited (100%) (Op.)	NELP	Shallow Water	1988	1988	Not on Production
50	KHARSANG	Assam-Arakan Shelf	Geo Enpro (10%) (Op.), Oil India Ltd. (40%), Jubilant Energy (Kharsang) Pvt. Ltd. (25%), Geo-Petrol International Inc. (25%)	Field	Onland	9.94	9.94	Production
51	LOHAR	Cambay	Selan Expl. Tech. Ltd. (100%) (Op.)	Field	Onland	5	5	Production
52	MB-OSN-2005/1	Mumbai	Oil and Natural Gas Corporation Ltd. (80%) (Op.), Gujarat State Petroleum Corporation Ltd. (20%)	NELP	Shallow Water	2811	501.06	Development
53	MB-OSN-2005/2	Mumbai	Adani Welspun Exploration Ltd. (100%) (Op.)	NELP	Shallow Water	1191	705.57	Exploratory
54	MODHERA	Cambay	Sun Petrochemical Pvt. Ltd. (100%) (Op.)	Field	Onland	12.7	12.7	Production
55	MZ-ONN-2004/1	Assam-Arakan Fold Belt	Oil India Ltd. (85%) (Op.), Shiv - Vani (15%)	NELP	Onland	3213	3213	Exploratory
56	N.BALOL	Cambay	Hindustan Oil Exploration Company Limited. (25%) (Op.), Gujarat State Petroleum Corporation Ltd. (45%), GNRL Oil & Gas Limited Ltd. (30%)	Field	Onland	27.3	27.3	Production
57	NEC-OSN-97/2	Mahanadi	Reliance Industries Ltd. (66.67%) (Op.), BP Exploration (Alpha) (33.33%)	NELP	Shallow Water	14535	831.73	Exploratory
58	NORTH KATHANA	Cambay	GNRL Oil & Gas Limited Ltd. (100%) (Op.)	Field	Onland	12.2	12.2	Production
59	PY-1	Cauvery	Hindustan Oil Exploration Company Limited. (100%) (Op.)	Field	Shallow Water	75	75	Production



Sr No.	Block Name	Basin	Consortium (Participating Interest In %)	Bid Round	Location	Awarded Area (In Sq.km)	Present Area (In Sq.km)	Status Of Block
60	PY-3	Cauvery	Hardy Exploration & Production (India) Inc. (18%) (Op.), Oil and Natural Gas Corporation Ltd. (40%), Tata Petrodyne Ltd. (21%), Hindustan Oil Exploration Company Limited. (21%)	Pre-NELP	Shallow Water	81	81	Not on Production
61	RAVVA	Krishna Godavari	Vedanta Limited (22.5%) (Op.), Oil and Natural Gas Corporation Ltd. (40%), Ravva Oil Pte. Ltd. (12.5%), Videocon Petroleum Limited. (25%)	Field	Shallow Water	331.26	311.56	Production
62	RJ-ON/6	Rajasthan	Focus Energy Ltd. (7%) (Op.), Oil and Natural Gas Corporation Ltd. (30%); iServices Investment Ltd. (45.5%), Newbury Oil Company Ltd. (17.5%)	Pre-NELP	Onland	5378	176	Production
63	RJ-ON-90/1	Rajasthan	Vedanta Limited (35%) (Op.), Oil and Natural Gas Corporation Ltd. (30%), Cairn Energy Hydrocarbon Ltd	Pre-NELP	Onland	11108	3111.17	Production
64	UNAWA	Cambay	GNRL Oil & Gas Limited Ltd. (100%) (Op.)	Field	Onland	5.65	5.65	Production
65	VN-ONN-2009/3	Vindhyan	Oil and Natural Gas Corporation Ltd. (100%) (Op.)	NELP	Onland	1250	462	Exploratory
66	WAVEL	Cambay	Joshi Technologies International Inc. (100%) (Op.)	Field	Onland	9	9	Production
67	WB-ONN-2005/4	Bengal-Purnea	Oil and Natural Gas Corporation Ltd. (75%) (Op.), Oil India Ltd. (25%)	NELP	Onland	3940	21-06-1906	Exploratory



Table 10.2: Contract Areas Awarded under Discovered Small Field Round-I (as on 31.03.2024)

Sl. No	Basin	Block Name	Consortium (Participating Inter- est In %)	Date Of Signing Contract	Awarded Area	Relinq . Area	Pres- ent Area	Status	
					(in sq.km)				
ACTIVE BLOCKS (15 BLOCKS), PML AWAITED (4 BLOCKS), TERMINATED (11 BLOCKS)									
SHALLOW WATER (09 BLOCKS)									
1	MB	MB/OSDSF/B37/2016	SUNPETRO (100%)	27-03-2017	124.00	124.00	-	Terminat- ed	
2		MB/OSDSF/B9/2016	ADANI WELSPUN EXPLORATION LTD. (100%)	27-03-2017	183.00	-	183.00	Active	
3		MB/OSDSF/B15/2016	BPRL (100%)	27-03-2017	41.00	41.00	-	Terminat- ed	
4		MB/OSDSF/B127E/2016	BPRL (100%)	27-03-2017	39.30	39.30	-	Terminat- ed	
5		MB/OSDSF/B80/2016	HOEC(60%) (Op.), Ad- bhoot Estates Private Limited (40%)	27-03-2017	56.02	-	56.02	Active	
6	GK	GK/OSDSF/KD/2016	IOCL (100%)	27-03-2017	46.00	46.00	-	Terminat- ed	
7	KG	KG/OSDSF/GSKV1/2016	AVR OIL (100%)	27-03-2017	24.20	-	24.20	Active	
SUB TOTAL					513.52	250.30	263.22		
ONLAND (23 BLOCKS)									
8	AA	AA/ONDSF/HILARA/2016	PPCL (100%)	27-03-2017	9.60	9.60	-	Terminat- ed	
9		AA/ONDSF/LAXMI- JAN/2016	MEIL (100%)	27-03-2017	8.90	-	8.90	Active	
10		AA/ONDSF/PATHA- RIA/2016	VBIPL (100%)	27-03-2017	19.15	19.15	-	Terminat- ed	
11		AA/ONDSF/BARSIL- LA/2016	RIPL (29%) (Op.), BDNEPL (29%), DFPL (23%), MIPL (19%)	27-03-2017	6.22	-	6.22	Active	
12		AA/ONDSF/CHARA- IDEO/2016	OILMAX (100%)	27-03-2017	11.50	-	11.50	Active	
13		AA/ONDSF/ DIPLING/2016	RIPL (29%) (Op.), BDNEPL (29%), DFPL (23%), MIPL (19%)	27-03-2017	28.17	-	28.17	Active	
14		AA/ONDSF/DUARMA- RA/2016	OILMAX (50%), Ante- lopus Energy Private Limited (50%)	27-03-2017	8.91	-	8.91	Active	
15		AA/ONDSF/JERAIPA- THAR/2016	IOCL (100%)	27-03-2017	10.10	10.10	-	Terminat- ed	
16		AA/ONDSF/KHER- EM/2016	HOEC (40%) (Op.), OIL (40%), PPCL (20%)	27-03-2017	16.45	-	16.45	PML awaited	
17		CB/ONDSF/ELAO/2016	PFHOGPL (100%)	27-03-2017	9.98	-	9.98	Active	
18		CB	CB/ONDSF/SOUTH PA- TAN/2016	SACFZE (100%)	27-03-2017	9.88	-	9.88	Active
19		CB/ONDSF/KHAM- BEL/2016	MEIL (100%)	27-03-2017	9.78	-	9.78	Active	



Sl. No	Basin	Block Name	Consortium (Participating Inter- est In %)	Date Of Signing Contract	Awarded Area	Relinq . Area	Pres- ent Area	Status
					(in sq.km)			
20	CY	CB/ONDSF/KAM- BOI/2016	NIPPON (100%)	27-03-2017	2.35	-	2.35	Active
21		CB/ONDSF/WEST BE- CHRAJI/2016	NIPPON (100%)	27-03-2017	9.15	-	9.15	Active
22		CY/ONDSF/NEDU- VASAL/2016	GEMPLPL (100%)	27-03-2017	10.01	-	10.01	PML awaited
23		CY/ONDSF/KARAI- KAL/2016	BPRL (100%)	27-03-2017	10.40	-	10.40	PML awaited
24	KG	KG/ONDSF/ACHAN- TA/2016	PFHOGPL (100%)	27-03-2017	9.63	-	9.63	Active
25		KG/ONDSF/BHIMANA- PALLI/2016	PFHOGPL (100%)	27-03-2017	15.10	-	15.10	Active
26		KG/ONDSF/KORAVA- KA/2016	KEI-RSOS (100%)	27-03-2017	9.90	-	9.90	PML awaited
27		KG/ONDSF/ SANARUDRA- VARAM/2016	PPCL (100%)	27-03-2017	9.35	9.35	-	Terminat- ed
28	RJ	RJ/ONDSF/BAKHRI TIB- BA/2016	BPRL (100%)	27-03-2017	13.40	13.40	-	Terminat- ed
29		RJ/ONDSF/SADEWA- LA/2016	BPRL (100%)	27-03-2017	10.30	10.30	-	Terminat- ed
30	VN	VN/ONDSF/NOHTA/2016	IOCL (100%)	27-03-2017	15.00	15.00	-	Terminat- ed
SUB TOTAL					263.23	86.90	176.33	
TOTAL AREA :					776.75	337.20	439.55	



Table 10.3: Contract Areas Awarded under Discovered Small Field Bid Round-II (as on 31.03.2024)

Sl. No	Basin	Block Name	Consortium (Participating In- terest In %)	Date Of Signing Contract	Awarded Area	Relinq . Area	Present Area	Status
					(in sq.km)			
ACTIVE BLOCKS (16 BLOCKS), PML AWAITED (3 BLOCKS), TERMINATED (5 BLOCKS)								
SHALLOW WATER (09 BLOCKS)								
1	KG	KG/OSDSF/G4/2018	GEMPETRO (100%)	3/7/2019	91.85	91.85	-	Terminat- ed
2		KG/OSDSF/GSKW/2018	OIL (100%)	3/7/2019	93.91	-	93.91	Active
3	MB	MB/OSDSF/CA/2018	ONGC (100%)	3/7/2019	343.95	-	343.95	Active
4		MB/OSDSF/D31/2018	ARCH (100%)	3/7/2019	271.77	-	271.77	Active
5		MB/OSDSF/NMT/2018	ONGC (100%)	3/7/2019	96.15	-	96.15	Active
6		MB/OSDSF/SB15/2018	ONGC (100%)	3/7/2019	226.16	-	226.16	Active
7		MB/OSDSF/D33/2018	ONGC (100%)	3/7/2019	207.55	-	207.55	Active
8		MB/OSDSF/D18/2018	GGRPL (100%)	3/7/2019	90.86	-	90.86	Active
9	NEC	NEC/OSDSF/D11/2018	ARCH (100%)	3/7/2019	541.44	-	541.44	Active
SUB TOTAL					1,963.64	91.85	,871.79	
ONLAND (15 BLOCKS)								
10	AA	AA/ONDSF/Madhaka- li/2018	ARSH (100%)	3/7/2019	41.93	41.93	-	Terminat- ed
11		AA/ONDSF/Uma- tara/2018	IOCL (90%), HOEC (10%)	3/7/2019	52.03	-	52.03	Active
12		AA/ONDSF/Disaijan/2018	INVENIRE (100%)	3/7/2019	21.26	-	21.26	Active
13		AA/ONDSF/Tiphuk/2018	SHANTIGD (19%), BBPL (70%), SHAN- NO (11%)	3/7/2019	21.37	21.37	-	Terminat- ed
14		AA/ONDSF/Hazariga- on/2018	VEDANTA (100%)	3/7/2019	30.74	-	30.74	Active
15		AA/ONDSF/Tula- mara/2018	OIL (100%)	3/7/2019	47.23	-	47.23	Active
16	CB	CB/ONDSF/Vadatal/2018	GGRPL (100)	3/7/2019	194.97	-	194.97	Active
17		CB/ONDSF/A1/2018	SHANTIGD (19%), BBPL (70%), SHAN- NO (11%)	3/7/2019	151.99	151.99	-	Terminat- ed
18		CB/ONDSF/D45/2018	GGRPL (100%)	3/7/2019	66.82	66.82	-	Terminat- ed
19	RJ	RJ/ONDSF/Chinnewa- la/2018	ONGC (100%)	3/7/2019	73.00	-	73.00	Active
20	KG	KG/ONDSF/Palakol- lu/2018	GGRPL (100%)	3/7/2019	95.14	-	95.14	PML awaited
21		KG/ONDSF/Suryaraope- ta/2018	GGRPL (100%)	3/7/2019	98.43	-	98.43	PML awaited
22		KG/ONDSF/Kaza/2018	VEDANTA (100%)	3/7/2019	114.93	-	114.93	Active
23		KG/ONDSF/Gokarnapur- am/2018	KEERTHI (100%)	3/7/2019	26.20	-	26.20	PML awaited
24	CB	CB/ONDSF/Sangan- pur/2018	SHANTIGD (19%), BBPL (70%), SHAN- NO (11%)	1/20/2021	4.49	-	4.49	Active
SUB TOTAL					1,040.53	282.11	758.42	
TOTAL AREA :					3,004.17	373.96	2,630.21	



Table 10.4: Contract Areas Awarded under Discovered Small Field Bid Round-III (as on 31.03.2024)

SL. NO	BASIN	BLOCK NAME	CONSORTIUM (PARTICIPATING INTEREST IN %)	DATE OF SIGNING CONTRACT	AWARDED AREA	RELINQ. AREA	PRESENT AREA	Status
ACTIVE BLOCKS (24 BLOCKS), PML AWAITED (05 BLOCKS), PML NOT APPLIED (01 BLOCK), TERMINATED (01 BLOCK)								
DEEP WATER (01 BLOCK)								
1	KG	KG/DWDSF/GD10/2021	DPRL (100%)	09-09-2022	203.9		203.9	Active
SUB TOTAL					203.90	-	203.90	
SHALLOW WATER (19 BLOCKS)								
2	KG	KG/OSDSF/CHANDRIKA/2021	ONGC (70%) + IOCL (30%)	09-09-2022	697	-	697	Active
3		KG/OSDSF/GS49/2021	ONGC (100%)	09-09-2022	148.3	-	148.3	Active
4		KG/OSDSF/YS6/2021	ONGC (100%)	09-09-2022	169.4	-	169.4	Active
5		KG/OSDSF/GS21/2021	IMCIL (100%)	09-09-2022	111.1	-	111.1	Active
6		KG/OSDSF/G4/2021	VEDANTA (100%)	09-09-2022	115.7	-	115.7	Active
7		KG/OSDSF/RAVVA/2021	CHEMITECH (90%) + DRAVIDA (10%)	09-09-2022	19.7	-	19.7	PML not applied
8	MB	MB/OSDSF/B37/2021	ONGC (100%)	09-09-2022	135.2	-	135.2	Active
9		MB/OSDSF/Ratna/2021	ONGC (100%)	09-09-2022	340	-	340	Active
10		MB/OSDSF/WO5/2021	ONGC (70%) + IOCL (30%)	09-09-2022	1166.3	-	1166.3	Active
11		MB/OSDSF/B203/2021	IPL (100%)	09-09-2022	2006.5	-	2006.5	Active
12		MB/OSDSF/B66/2021	IPL (100%)	09-09-2022	225.7	-	225.7	Active
13		MB/OSDSF/B154N/2021	IPL (100%)	09-09-2022	342.6	-	342.6	Active
14		MB/OSDSF/B174/2021	VEDANTA (100%)	09-09-2022	282.7	-	282.7	Active
15		MB/OSDSF/BH68/2021	VEDANTA (100%)	09-09-2022	310.6	-	310.6	Active
16		MB/OSDSF/B15/2021	GGRPL (100%)	09-09-2022	332.4	32.40	0	Terminated
17	KUTCH	GK/OSDSF/GK28/2021	SUN PETRO (100%)	09-09-2022	1455.8	-	1455.8	Active
18		GK/OSDSF/GK1/2021	VEDANTA (100%)	09-09-2022	636.5	-	636.5	Active
19	CAM-BAY	CB/OSDSF/GULFA/2021	SUN PETRO (100%)	09-09-2022	73	-	73	Active
20		CB/OSDSF/AMBE/2021	VEDANTA (100%)	09-09-2022	728.2	-	728.2	Active
SUB TOTAL					9,296.70	32.40	8,964.30	



SL. NO	BASIN	BLOCK NAME	CONSORTIUM (PARTICIPATING INTEREST IN %)	DATE OF SIGNING CONTRACT	AWARDED AREA	RELINQ. AREA	PRESENT AREA	Status
ONLAND (11 BLOCKS)								
21	AA	AA/ONDSF/PATHARIA/2021	VEDANTA (100%)	09-09-2022	96.5	-	96.5	Active
22		AA/ONDSF/TUKBAI/2021	VEDANTA (100%)	09-09-2022	494.3	-	494.3	Active
23		AA/ONDSF/TIPHUK/2021	OEPL (100%)	09-09-2022	21.4	-	21.4	Active
24	KG	KG/ONDSF/DANGURU/2021	ANTELOPUS (100%)	09-09-2022	144.3	-	144.3	PML awaited
25		KG/ONDSF/KAVITAM/2021	IMCIL (100%)	09-09-2022	142.7	-	142.7	PML awaited
26		KG/ONDSF/Sanarudravaram/2021	APOLLO ENERGY CO. LTD. (100%)	09-09-2022	147.7	-	147.7	PML awaited
27	RJ	RJ/ONDSF/BakhriTibba/2021	OIL (100%)	09-09-2022	66.7	-	66.7	Active
28		RJ/ONDSF/Punam/2021	MEIL (100%)	09-09-2022	27.3	-	27.3	Active
29	CB	CB/ONDSF/INDORARA/2021	OEPL (50%) + AESL (50%)	09-09-2022	150.8	-	150.8	Active
30	CAUV-ERY	CY/ONDSF/VADATHE- RU/2021	APOLLO ENERGY CO. LTD. (100%)	09-09-2022	463.3	-	463.3	PML awaited
31	VN	VN/ONDSF/NOHTA/2021	VEDANTA (100%)	09-09-2022	1471.7	-	1471.7	PML awaited
SUB TOTAL					3,226.70	-	3,226.70	
TOTAL AREA :					12,727.30	332.40	12,394.90	



Table 10.5: Exploration Blocks Awarded under First Round of OALP (OALP-I) (as on 31.03.2024)

SL. NO	BASIN	BLOCK NAME	CONSORTIUM (PARTICIPATING INTEREST IN %)	DATE OF SIGNING CONTRACT	AWARDED AREA	RELINQ. AREA
					(in sq.km)	
Total Blocks : 55 Relinquished Blocks : 6						
Onland						
1	AA	AA-ONHP-2017/1	Vedanta Limited	01.10.2018	714.71	
2		AA-ONHP-2017/10	Oil India Limited (70), ONGC (30)	01.10.2018	543.28	
3		AA-ONHP-2017/11	Vedanta Limited	01.10.2018	784.55	
4		AA-ONHP-2017/12	Oil India Limited (60), IOCL(20), BPRL(10), NRL(10)	01.10.2018	489.06	
5		AA-ONHP-2017/13	Oil India Limited (70), ONGC (30)	01.10.2018	840.69	
6		AA-ONHP-2017/14	Vedanta Limited	01.10.2018	1719.17	
7		AA-ONHP-2017/15	Vedanta Limited	01.10.2018	1367.38	
8		AA-ONHP-2017/16	Oil India Limited	01.10.2018	361.49	
9		AA-ONHP-2017/17	Oil India Limited	01.10.2018	309.07	
10		AA-ONHP-2017/18	Oil India Limited	01.10.2018	1711.10	
11		AA-ONHP-2017/19	HOEC	01.10.2018	79.21	
12		AA-ONHP-2017/2	Vedanta Limited	01.10.2018	73.19	
13		AA-ONHP-2017/20	Oil India Limited (70), NRL(30), AHECL(10)	01.10.2018	125.08	
14		AA-ONHP-2017/3	Vedanta Limited	01.10.2018	267.94	
15		AA-ONHP-2017/4	Vedanta Limited	01.10.2018	839.33	
16		AA-ONHP-2017/5	Vedanta Limited	01.10.2018	758.23	
17		AA-ONHP-2017/6	Vedanta Limited	01.10.2018	278.79	
18		AA-ONHP-2017/8	Vedanta Limited	01.10.2018	610.54	
19		AA-ONHP-2017/9	Vedanta Limited	01.10.2018	18.32	
20	CB	CB-ONHP-2017/1	Vedanta Limited	01.10.2018	1490.40	
21		CB-ONHP-2017/10	Vedanta Limited	01.10.2018	2765.60	
22		CB-ONHP-2017/11	Vedanta Limited	01.10.2018	69.66	
23		CB-ONHP-2017/12	GAIL	01.10.2018	212.27	
24		CB-ONHP-2017/2	Vedanta Limited	01.10.2018	317.38	
25		CB-ONHP-2017/3	Vedanta Limited	01.10.2018	82.57	
26		CB-ONHP-2017/4	Vedanta Limited	01.10.2018	95.10	
27		CB-ONHP-2017/5	Vedanta Limited	01.10.2018	990.10	
28		CB-ONHP-2017/6	Vedanta Limited	01.10.2018	18.91	
29		CB-ONHP-2017/7	Vedanta Limited	01.10.2018	1335.45	
30		CB-ONHP-2017/9	BPRL (60), ONGC(40)	01.10.2018	173.71	
31	CY	CY-ONHP-2017/1	ONGC Limited(60), BPRL(40)	01.10.2018	730.79	730.79
32	GK	GK-ONHP-2017/1	Vedanta Limited	01.10.2018	2690.23	
33	GV	GV-ONHP-2017/1	Vedanta Limited	01.10.2018	1816.73	



SL. NO	BASIN	BLOCK NAME	CONSORTIUM (PARTICIPATING INTEREST IN %)	DATE OF SIGNING CONTRACT	AWARDED AREA	RELINQ. AREA
					(in sq.km)	
34	HF	HF-ONHP-2017/1	Vedanta Limited	01.10.2018	665.98	
35	KG	KG-ONHP-2017/1	Vedanta Limited	01.10.2018	2321.30	2321.30
36		KG-ONHP-2017/2	Vedanta Limited	01.10.2018	667.73	667.73
37		KG-ONHP-2017/3	Vedanta Limited	01.10.2018	49.16	49.16
38	RJ	RJ-ONHP-2017/1	Vedanta Limited	01.10.2018	542.33	
39		RJ-ONHP-2017/2	Vedanta Limited	01.10.2018	1071.97	
40		RJ-ONHP-2017/3	Vedanta Limited	01.10.2018	1429.56	
41		RJ-ONHP-2017/4	Vedanta Limited	01.10.2018	1087.29	
42		RJ-ONHP-2017/5	Vedanta Limited	01.10.2018	916.60	
43		RJ-ONHP-2017/6	Vedanta Limited	01.10.2018	924.60	
44		RJ-ONHP-2017/7	Vedanta Limited	01.10.2018	602.63	
45		RJ-ONHP-2017/8	Oil India Limited(70), IOCL(30)	01.10.2018	515.91	515.91
46		RJ-ONHP-2017/9	Oil India Limited	01.10.2018	3012.13	3012.13
SUB TOTAL					38487.22	7297.02
SHALLOW WATER						
47	CY	CY-OSHP-2017/1	Vedanta Limited	01.10.2018	1793.93	140.46
48		CY-OSHP-2017/2	Vedanta Limited	01.10.2018	2573.52	180.49
49	GK	GK-OSHP-2017/1	Vedanta Limited	01.10.2018	2960.25	
50	GS	GS-OSHP-2017/1	Vedanta Limited	01.10.2018	2627.33	
51	GS	GS-OSHP-2017/2	Vedanta Limited	01.10.2018	674.29	
52	KG	KG-OSHP-2017/1	Vedanta Limited	01.10.2018	177.37	
53	MB	MB-OSHP-2017/1	ONGC Limited	01.10.2018	724.72	
54	MB	MB-OSHP-2017/2	Vedanta Limited	01.10.2018	2690.46	
SUB TOTAL					14221.87	320.95
DEEP WATER						
55	KG	KG-DWHP-2017/1	Vedanta Limited	01.10.2018	6574.26	0.00
SUB TOTAL					6574.26	0.00
TOTAL AREA :					59283.35	7617.97



Table 10.6: Exploration Blocks Awarded under Second Round of OALP (OALP-II) (as on 31.03.2024)

SL. NO	BASIN	BLOCK NAME	CONSORTIUM (PARTICIPATING INTEREST IN %)	DATE OF SIGNING CONTRACT	AWARDED AREA	RELINQ. AREA
(in sq.km)						
Total Blocks : 14 Relinquished Blocks : 1						
Onland						
1	CB	CB-ONHP-2018/1	Vedanta Limited	16.07.2019	185.27	
2		CB-ONHP-2018/2	ONGC Limited	16.07.2019	846.82	846.82
3	CY	CY-ONHP-2018/1	IOCL	16.07.2019	474.19	
4	MN	MN-ONHP-2018/1	Oil India Limited	16.07.2019	2933.85	
5		MN-ONHP-2018/2	Oil India Limited	16.07.2019	2539.51	
6		MN-ONHP-2018/3	Oil India Limited	16.07.2019	3138.59	
7		MN-ONHP-2018/4	Oil India Limited	16.07.2019	3196.86	
8	RJ	RJ-ONHP-2018/1	Vedanta Limited	16.07.2019	417.44	
SUB TOTAL					13732.53	846.82
SHALLOW WATER						
9	AN	AN-OSHP-2018/1	Oil India Limited	16.07.2019	3669.25	
10		AN-OSHP-2018/2	Oil India Limited	16.07.2019	5947.45	
11	GK	GK-OSHP-2018/1	Vedanta Limited	16.07.2019	1731.78	
12		GK-OSHP-2018/2	Vedanta Limited	16.07.2019	812.54	
13	MN	MN-OSHP-2018/1	Vedanta Limited	16.07.2019	1825.07	
SUB TOTAL					13986.09	0.00
ULTRA - DEEP WATER						
14	KG	KG-UDWHP-2018/1	RIL (60),BP(40)	16.07.2019	1513.90	
SUB TOTAL					1513.90	0.00
TOTAL AREA :					29232.52	846.82



Table 10.7: Exploration Blocks Awarded under Third Round of OALP (OALP-III) (as on 31.03.2024)

SL. NO	BASIN	BLOCK NAME	CONSORTIUM (PARTICIPATING INTEREST IN %)	DATE OF SIGNING CONTRACT	AWARDED AREA	RELINQ. AREA
(in sq.km)						
Total Blocks : 18 Relinquished Blocks : 3						
Onland						
1	AS	AA-ONHP-2018/1	Vedanta Limited	16.07.2019	248.87	
2	AA	AA-ONHP-2018/2	Oil India Limited	16.07.2019	2526.74	
3	AA	AA-ONHP-2018/3	Oil India Limited(70), IOCL(30)	16.07.2019	1234.42	
4	AA	AA-ONHP-2018/4	ONGC Limited	16.07.2019	44.01	
5	AA	AA-ONHP-2018/5	Oil India Limited(70), IOCL(30)	16.07.2019	207.74	
6	BP	BP-ONHP-2018/1	ONGC Limited	16.07.2019	2468.00	
7	CB	CB-ONHP-2018/3	Vedanta Limited	16.07.2019	519.17	
8	CB	CB-ONHP-2018/4	Vedanta Limited	16.07.2019	558.72	
9	CY	CY-ONHP-2018/2	ONGC Limited	16.07.2019	459.83	459.83
10	CY	CY-ONHP-2018/3	ONGC Limited	16.07.2019	1403.41	
11	KG	KG-ONHP-2018/1	Vedanta Limited	16.07.2019	2600.95	2600.95
12	KG	KG-ONHP-2018/2	Vedanta Limited	16.07.2019	230.29	230.29
13	MN	MN-ONHP-2018/5	Oil India Limited	16.07.2019	2299.74	
14	RJ	RJ-ONHP-2018/2	Oil India Limited(70), IOCL(30)	16.07.2019	3016.34	
SUB TOTAL					17,818.23	3,291.07
SHALLOW WATER						
15	MB	KK-OSHP-2018/1	Oil India Limited	16.07.2019	3519.69	
16		MB-OSHP-2018/1	ONGC Limited	16.07.2019	1267.96	
17		MB-OSHP-2018/2	ONGC Limited	16.07.2019	4668.06	9.52
18	KK	MN-DWHP-2018/1	ONGC Limited	16.07.2019	2491.31	
SUB TOTAL					11,947.02	9.52
TOTAL AREA:					29,765	3,301

Table 10.8: Exploration Blocks Awarded under Fourth Round of OALP (OALP-IV) (as on 31.03.2024)

SL. NO	BASIN	BLOCK NAME	CONSORTIUM (PARTICIPATING INTEREST IN %)	DATE OF SIGNING CONTRACT	AWARDED AREA	RELINQ. AREA
(in sq.km)						
Total Blocks : 07 Relinquished Blocks : 0						
Onland						
1	BP	BP-ONHP-2019/1	ONGC Limited	02.01.2020	3131	
2	RJ	RJ-ONHP-2019/1	ONGC Limited	02.01.2020	2119	
3	VN	VN-ONHP-2019/1	ONGC Limited	02.01.2020	2731	
4	VN	VN-ONHP-2019/2	ONGC Limited	02.01.2020	3078	
5	VN	VN-ONHP-2019/3	ONGC Limited	02.01.2020	3097	
6	VN	VN-ONHP-2019/4	ONGC Limited	02.01.2020	2933	
7	VN	VN-ONHP-2019/5	ONGC Limited	02.01.2020	1422	
SUB TOTAL					18,510	-
TOTAL AREA :					18,510	-



Table 10.9: Exploration Blocks Awarded under Fifth Round of OALP (OALP-V) (as on 31.03.2024)

SL. NO	BASIN	BLOCK NAME	CONSORTIUM (PARTICIPATING INTEREST IN %)	DATE OF SIGNING CONTRACT	AWARDED AREA	RELINQ . AREA
						(in sq.km)
Total Blocks : 11 Relinquished Blocks : 1						
Onland						
1	AS	AA-ONHP-2019/1	Oil India Limited	17.11.2020	1278	
2	AS	AA-ONHP-2019/2	Oil India Limited	17.11.2020	2405	2405.12
3	BP	BP-ONHP-2019/2	ONGC Limited	17.11.2020	3170	
4	CB	CB-ONHP-2019/1	ONGC Limited	17.11.2020	19	
5	CB	CB-ONHP-2019/2	ONGC Limited	17.11.2020	153	
6	GK	GK-ONHP-2019/1	ONGC Limited	17.11.2020	1693	
7	RJ	RJ-ONHP-2019/2	Oil India Limited(70), IOCL(30)	17.11.2020	1520	
8	RJ	RJ-ONHP-2019/3	Oil India Limited(70), IOCL(30)	17.11.2020	1819	
SUB TOTAL					12057	2405
Shallow Water						
9	GS	GS-OSHP-2019/1	ONGC Limited	17.11.2020	1421	
10	MB	MB-OSHP-2019/1	ONGC Limited	17.11.2020	2247	
11	CY	CY-UDWHP-2019/1	ONGC Limited	17.11.2020	4064	
SUB TOTAL					7732	0
TOTAL AREA :					19789	2405



Table 10.10: Exploration Blocks Awarded under Sixth Round of OALP (OALP-VI) (as on 31.03.2024)

SL. NO	BASIN	BLOCK NAME	CONSORTIUM (PARTICIPATING INTEREST IN %)	DATE OF SIGNING CONTRACT	AWARDED AREA	RELINQ. AREA
(in sq.km)						
Total Blocks : 21 Relinquished Blocks : 0						
Onland						
1	CB	CB-ONHP-2020/1	ONGC Limited	27.04.2022	44.13	
2	AA	AA-ONHP-2020/1	Oil India Limited	27.04.2022	557.33	
3	AA	AA-ONHP-2020/2	ONGC Limited	27.04.2022	50.41	
4	AA	AA-ONHP-2020/3	Oil India Limited	27.04.2022	219.37	
5	CD	CD-ONHP-2020/1	ONGC Limited	27.04.2022	3305.89	
6	NM	NM-ONHP-2020/1	ONGC Limited	27.04.2022	2999.15	
7	CB	CB-ONHP-2021/1	ONGC Limited	27.04.2022	113.74	
8	CB	CB-ONHP-2021/2	ONGC Limited	27.04.2022	28.59	
9	GK	GK-ONHP-2021/1	ONGC Limited	27.04.2022	313.64	
10	GS	GS-ONHP-2021/1	ONGC Limited	27.04.2022	2483.64	
11	GV	GV-ONHP-2021/1	ONGC Limited	27.04.2022	308.32	
12	GV	GV-ONHP-2021/2	ONGC Limited	27.04.2022	302.57	
13	BP	BP-ONHP-2021/1	ONGC Limited	27.04.2022	2872.56	
14	AA	AA-ONHP-2021/1	ONGC Limited	27.04.2022	37.68	
15	AS	AS-ONHP-2021/1	ONGC Limited	27.04.2022	24.64	
SUB TOTAL					13661.66	0.00
Shallow Water						
16	MB	MB-OSHP-2020/1	ONGC Limited	27.04.2022	956.10	
17	MB	MB-OSHP-2020/2	ONGC Limited	27.04.2022	427.17	
18	CB	CB-OSHP-2021/1	SunPetro	29.04.2022	472.56	
19	MB	MB-OSHP-2021/1	ONGC Limited	27.04.2022	6183.17	
SUB TOTAL					8039.00	0.00
Ultra-Deep Water						
20	AN	AN-UDWHP-2020/1	ONGC Limited	27.04.2022	3995.25	
21	AN	AN-UDWHP-2020/2	ONGC Limited	27.04.2022	9650.12	
SUB TOTAL					13645.37	0.00
TOTAL AREA :					35346.03	0.00



**Table 10.11: Exploration Blocks Awarded under Seventh Round of OALP (OALP-VII)
(as on 31.03.2024)**

SL. NO	BASIN	BLOCK NAME	CONSORTIUM (PARTICIPATING INTEREST IN %)	DATE OF SIGNING CONTRACT	AWARDED AREA	RELINQ. AREA
						(in sq.km)
Total Blocks : 8 Relinquished Blocks : 0						
Onland						
1	RJ	RJ-ONHP-2021/1	GAIL	28.06.2022	486.39	
2	AA	AA-ONHP-2021/2	ONGC Limited	28.06.2022	382.05	
3	SR	SR-ONHP-2021/1	ONGC Limited	28.06.2022	906.43	
4	AS	AS-ONHP-2021/2	Oil India Limited	28.06.2022	2445.30	
5		AS-ONHP-2021/3	Oil India Limited	28.06.2022	1840.87	
SUB TOTAL					6061.04	0.00
Shallow Water						
6	CB	CB-OSHP-2021/2	SunPetro	28.06.2022	1234.42	
7		CB-OSHP-2021/3	SunPetro	28.06.2022	361.85	
SUB TOTAL					1596.27	0.00
Ultra-Deep Water						
8	CY	CY-UDWHP-2021/1	ONGC Limited	28.06.2022	8108.69	
SUB TOTAL					8108.69	0.00
TOTAL AREA :					15766.00	0.00



Table 10.12: Exploration Blocks Awarded under Eighth Round of OALP (OALP-VIII) (as on 31.03.2024)

SL. NO	BASIN	BLOCK NAME	CONSORTIUM (PARTICIPATING INTEREST IN %)	DATE OF SIGNING CONTRACT	AWARDED AREA	RELINQ. AREA
						(in sq.km)
Total Blocks : 10 Relinquished Blocks : 0						
Onland						
1	AS	AS-ONHP-2022/1	Oil India Limited	1/3/2024	2057.63	
2	CB	CB-ONHP-2022/1	ONGC Limited	1/3/2024	188.52	
SUB TOTAL					2246.15	0.00
Shallow Water						
3	MB	MB-OSHP-2022/1	ONGC Limited	1/3/2024	4107.97	
4	GK	GK-OSHP-2022/1	Sun Petrochemicals Pvt Ltd.	1/3/2024	765.54	
5	BP	BP-OSHP-2022/1	ONGC Limited	1/3/2024	5754.92	
6	KK	KK-OSHP-2022/1	ONGC Limited	1/3/2024	6717.56	
SUB TOTAL					17345.99	0.00
Deep Water						
7	GS	GS-DWHP-2022/1	ONGC Limited	1/3/2024	2742.70	
8	KK	KK-DWHP-2022/1	ONGC Limited	1/3/2024	1112.71	
SUB TOTAL					3855.41	0.00
Ultra-Deep Water						
9	KG	KG-UDWHP-2022/1	RIL-BP (Consortium)	1/3/2024	1199.64	
10	MN	MN-UDWHP-2022/1	ONGC Limited	1/3/2024	9717.34	
SUB TOTAL					10916.98	0.00
TOTAL AREA :					34364.53	0.00

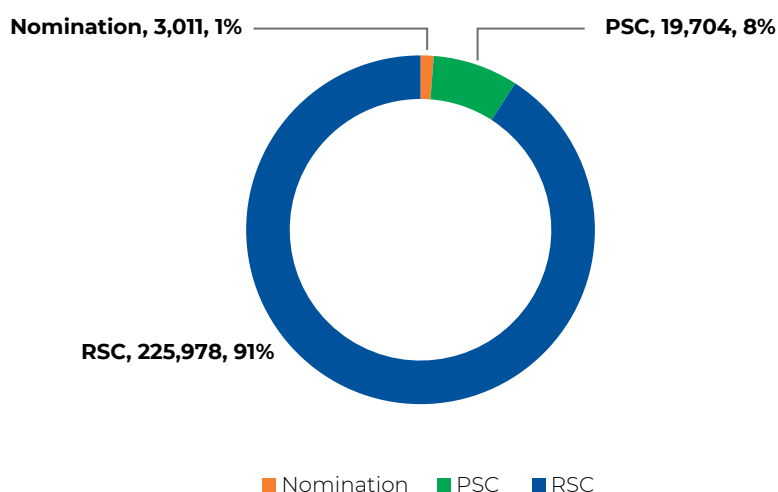
Figure 10.3: Regime Wise Area under PEL (as on 31.03.2024)

Table 10.13. Nomination PML & PEL operated by ONGC and OIL in India

Operator	Basin	Asset	Onshore / Offshore	Number of PML	Total PMLs	Area (Sq. Km.)	Number of PEL	Area (Sq. Km.)
ONGC	Cambay	Ahmedabad	Onshore	51	159	2279.498		
		Ankleshwar		47		1614.209		
		Cambay		23		745.81		
		Mehsana		38		1103.3		
	Rajasthan	RKOE (Rajasthan)		4	4	838.32		
	Assam Shelf	Assam		24	39	979.756	3	1583.11
		Jorhat		15		491.706		
	Assam Arakan Fold Belt	Silchar (CFB)		8	25	902.85		
	(AAFB)	Tripura		17		3026.705		
	Krishna Godavari	Rajahmundry		37	44	4288.742		
		Eastern Offshore	Offshore	7		580.62		
	Cauvery	Karaikal	Onshore	26	27	3955.384		
			Offshore	1		11		
	Mumbai Off-shore	Mumbai High	Offshore	7	28	14224.05	2	985*
		Neelam & Heera		5		1439.78		
		Bassein & Satellite		16		10378.283		
	Kutch					1	420**	
OIL	Assam Shelf	Arunanachal pradesh	Onshore	2	2	493.9	1	23.25
	Rajasthan	Assam		21	21	3888.23		
		Rajasthan		2	2	446.71		
		Total		351	351	51688.853	7	3011.36

* Only 985 Sq. Km. area is regularized. There are two PELs for area 7481 Sq. Km. & 8951 Sq. Km. (Total 16432 Sq. Km.) in Mumbai offshore. One PEL for 7481 Sq. Km. is under relinquishment while for other PEL only 985 Sq. Km. is regularized out of 8951 Sq. Km..

**Only 420 Sq. Km. is regularized. The total area in Kutch Basin as per earlier re-grant is 16557 Sq. Km..

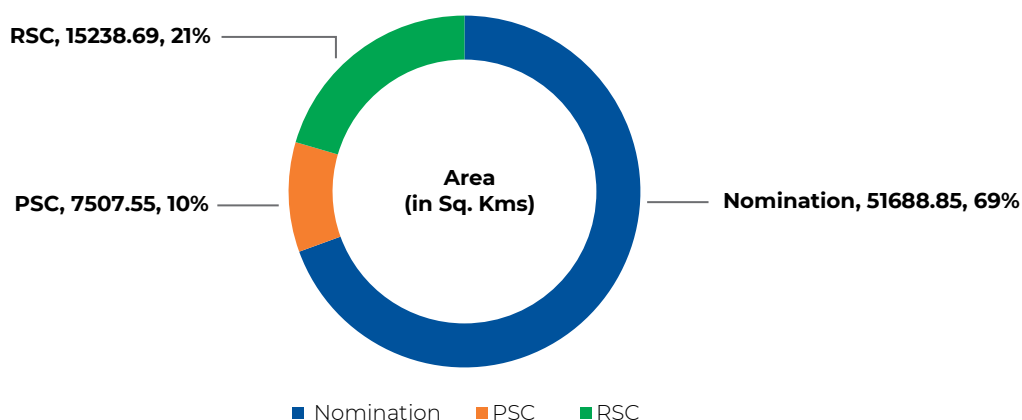
Figure 10.4: Regime wise PML area (as on 31.03.2024)

Table 10.14: Active Contract Areas under Discovered Field Rounds (As on 31.03.2024)

SL. NO.	Bid Round	BLOCK/FIELD NAME	OPERATOR	BASIN	ML Effective Date	ML AREA (Sq. Km.)
1	DSF-I	AA/ONDSF/BARSIL-LA/2016	Ramyana Ispat Private Limited (29%), BDN Enterprises Private Limited (29%), Duggar Fiber Private Limited (23%), Mahendra Infratech Private Limited (19%)	Assam Arakan	22.06.17	6.22
2	DSF-I	AA/ONDSF/DIPLING/2016	Ramyana Ispat Private Limited (29%), BDN Enterprises Private Limited (29%), Duggar Fiber Private Limited (23%), Mahendra Infratech Private Limited (19%)	Assam Arakan	22.06.17	28.17
3	DSF-I	AA/ONDSF/CHARA-IDEO/2016	Oilmax Energy Private Limited	Assam Arakan	26.07.17	11.50
4	DSF-I	AA/ONDSF/DUARMARA/2016	Oilmax Energy Private Limited (50%), Antelopus Energy Private Limited (50%)	Assam Arakan	26.07.17	8.91
5	DSF-I	AA/ONDSF/LAXMI-JAN/2016	Megha Engineering and Infra-structures Limited	Assam Arakan	21.04.18	8.90
6	DSF-I	CB/ONDSF/KAM-BOI/2016	Nippon Power Limited	Cambay	04.08.17	2.35
7	DSF-I	CB/ONDSF/WEST BECHRAJI/2016	Nippon Power Limited	Cambay	04.08.17	9.15
8	DSF-I	CB/ONDSF/ELAO/2016	PFH Oil & Gas Private Limited	Cambay	04.08.17	9.98
9	DSF-I	CB/ONDSF/KHAM-BEL/2016	MEIL (100 %)	Cambay	08.08.17	9.78
10	DSF-I	CB/ONDSF/SOUTH PATAN/2016	South Asia Consultancy FZE	Cambay	08.08.17	9.88
11	DSF-I	KG/ONDSF/BHI-MANAPALLI/2016	PFH Oil & Gas Private Limited	Krishna-Godavari (KG)	24.04.18	15.10
12	DSF-I	KG/ONDSF/ACHANTA/2016	PFH Oil & Gas Private Limited	Krishna-Godavari (KG)	29.06.18	9.63
13	DSF-I	KG/OSDSF/GSKV1/2016	AVR OIL	Krishna-Godavari (KG)	02.06.17	24.20
14	DSF-I	MB/OSDSF/B80/2016	Hindustan Oil Exploration Company Limited (60%), Adbhoot Estates Private Limited (40%)	Mumbai Offshore	11.05.17	56.02
15	DSF-I	MB/OSDSF/B9/2016	Adani Welspun Exploration Limited	Mumbai Offshore	11.05.17	183.00
16	DSF II	AA/ONDSF/Umatara/2018	Indian Oil Corporation Limited (90%), Hindustan Oil Exploration Company Limited (10%)	Assam Shelf	03.12.2019	52.03
17	DSF II	AA/ONDSF/Disaijan/2018	Invenire Energy Private Limited	Assam Shelf	10.01.2020	21.26
18	DSF II	AA/ONDSF/Hazariganon/2018	Vedanta Ltd.	Assam Shelf	4/24/2020	30.70
19	DSF II	AA/ONDSF/Tulamarara/2018	Oil India Limited	Assam-Arakan Fold Belt	14.11.2019	47.23
20	DSF II	CB/ONDSF/Vadatal/2018	Ganges Geo Resources Private Limited	Cambay	08.01.2020	194.97



SL. NO.	Bid Round	BLOCK/FIELD NAME	OPERATOR	BASIN	ML Effective Date	ML AREA (Sq. Km.)
21	DSF II	RJ/ONDSF/Chinnewa-la/2018	ONGC (100%)	Rajasthan	02.12.2019	73.00
22	DSF II	KG/OSDSF/GSKW/2018	Oil India Limited	Krishna-Go-davari (KG)	08.07.2019	93.90
23	DSF II	MB/OSDSF/CA/2018	ONGC (100%)	Mumbai Offshore	25.06.2019	343.95
24	DSF II	MB/OSDSF/D31/2018	Arch Softwares Private Limited	Mumbai Offshore	09.08.2019	271.77
25	DSF II	MB/OSDSF/NMT/2018	ONGC (100%)	Mumbai Offshore	08.07.2019	96.15
26	DSF II	MB/OSDSF/SB15/2018	ONGC (100%)	Mumbai Offshore	08.07.2019	226.16
27	DSF II	MB/OSDSF/D33/2018	ONGC (100%)	Mumbai Offshore	08.07.2019	207.55
28	DSF II	MB/OSDSF/D18/2018	Ganges Geo Resources Private Limited	Mumbai Offshore	08.07.2019	90.86
29	DSF II	NEC/OSDSF/D11/2018	Arch Softwares Private Limited	Bengal-Pur-nea Basin / Mahanadi Offshore	09.08.2019	541.44
30	DSF-II	KG/ONDSF/KAZA/2018	Vedanta Ltd.	Krishna-Go-davari (KG)	1/18/2023	114.93
31	DSF II	CB/ONDSF/Sangan-pur/2018	"Shanti G.D. Ispat and Power Pvt. Ltd. (19%), Bagadiya Brothers Private Limited (70%), Shanno Business India Private Limited (11%)"	Cambay	7/7/2023	4.49
32	DSF-III	KG/OSDSF/CHANDRI-KA/2021	ONGC (70%) + IOCL (30%)	Krishna-Go-davari (KG)	9/9/2022	697.00
33	DSF-III	KG/OSDSF/GS49/2021	ONGC (100%)	Krishna-Go-davari (KG)	9/9/2022	148.30
34	DSF-III	KG/OSDSF/YS6/2021	ONGC (100%)	Krishna-Go-davari (KG)	9/9/2022	169.40
35	DSF-III	KG/OSDSF/GS21/2021	IMCIL (100%)	Krishna-Go-davari (KG)	9/9/2022	111.10
36	DSF-III	KG/OSDSF/G4/2021	VEDANTA (100%)	Krishna-Go-davari (KG)	9/9/2022	115.70
37	DSF-III	KG/DWDSF/GD10/2021	DPRL (100%)	Krishna-Go-davari (KG)	3/31/2023	203.90
38	DSF-III	MB/OSDSF/B37/2021	ONGC (100%)	Mumbai Offshore	9/9/2022	135.20
39	DSF-III	MB/OSDSF/Rat-na/2021	ONGC (100%)	Mumbai Offshore	9/9/2022	340.00
40	DSF-III	MB/OSDSF/WO5/2021	ONGC (70%) + IOCL (30%)	Mumbai Offshore	9/9/2022	1166.30
41	DSF-III	MB/OSDSF/B203/2021	IPL (100%)	Mumbai Offshore	9/9/2022	2006.50
42	DSF-III	MB/OSDSF/B66/2021	IPL (100%)	Mumbai Offshore	9/9/2022	225.70
43	DSF-III	MB/OSDSF/B154N/2021	IPL (100%)	Mumbai Offshore	9/9/2022	342.60



SL. NO.	Bid Round	BLOCK/FIELD NAME	OPERATOR	BASIN	ML Effective Date	ML AREA (Sq. Km.)
44	DSF-III	MB/OSDSF/B174/2021	VEDANTA (100%)	Mumbai Offshore	9/9/2022	282.70
45	DSF-III	MB/OSDSF/BH68/2021	VEDANTA (100%)	Mumbai Offshore	9/9/2022	310.60
46	DSF-III	GK/OSDSF/GK28/2021	SUN PETRO (100%)	Kutch Off-shore	9/9/2022	1455.80
47	DSF-III	GK/OSDSF/GK1/2021	VEDANTA (100%)	Kutch Off-shore	9/9/2022	636.50
48	DSF-III	CB/OSDSF/GUL-FA/2021	SUN PETRO (100%)	Cambay Offshore	9/9/2022	73.00
49	DSF-III	CB/OSDSF/AMBE/2021	VEDANTA (100%)	Cambay Offshore	9/9/2022	728.20
50	DSF-III	CB/ONDSF/INDRO-RA/2021	OEPL (50%) + AESL (50%)	Cambay	4/1/2023	150.80
51	DSF-III	RJ/ONDSF/BakhrīTibba/2021	OIL (100%)	Rajasthan	6/16/2023	66.70
52	DSF-III	RJ/ONDSF/Punam/2021	MEIL (100%)	Rajasthan	3/1/2024	27.30
53	DSF-III	AA/ONDSF/TI-PHUK/2021	OEPL (100%)	Assam Shelf	12-07-2023*	21.40
54	DSF-III	AA/ONDSF/PATHARIA/2021	VEDANTA (100%)	Assam- Arakan fold belt	04-11-2022*	96.50
55	DSF-III	AA/ONDSF/TUKBAI/2021	VEDANTA (100%)	Assam- Arakan fold belt	04-11-2022*	494.30
Total of MLs awarded in RSC (DSF) regime						12808.69

* PML Granted, Effective date will be commenced after signing of PML deed





Team behind successful publication

Left to Right: Mr. Partha Pratim Das, Mr. R. K. Jain, Mr. Prabhakar Thakur, Mr. Alok Dwivedi, Mr. Manish Gupta, Mr. Gautam Sinha, Mr. Kumar Prabhakar, Mr. Ashish Batham, Mr. Sanjay Kashinath Lale, Dr. Pallavi Jain Govil, IAS, (Director General), Mrs. Sushmita Baruah, Mrs. Kavita Bhardwaj, Mrs. Udisha Vatsa, Mrs. Pooja Singh, Mrs. Pooja Verma, Mr. Deepak Jain, Mr. Harish Chandola and Mr. Ujjal Ghosh



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